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TB 916 (1946)   USDA TECHNICAL BULLETINS   UPDATA
INVESTIGATIONS IN EROSION CONTROL AND RECLAMATION OF ERODED SANDY CLAY
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Technical Bulletin No. 916 · *June 1946*

UNITED STATES
DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

Investigations in Erosion Control and Reclamation of Eroded Sandy Clay Lands of Texas, Arkansas, and Louisiana at the Conservation Experiment Station, Tyler, Tex., 1931-40[1]

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The United States Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station

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[1] Submitted for publication October 18, 1945.

[2] Former members of the station staff who contributed to the planning and development of the research program are B. H. Hendrickson, Ralph W. Baird, and O. C. Word, Jr.

SUMMARY AND LAND USE RECOMMENDATIONS

Results of 10 years of research relating to soil and water conservation in the Texas-Arkansas-Louisiana Sandy Lands Region are reported. The chief aims of these investigations were to establish ratings on soil and water losses for the problem area, to develop better methods of conserving the topsoil, and to maintain its fertility. The effect of such factors as rainfall characteristics, soil series, slope, plant cover, cropping systems, strip cropping, terracing, and land use on soil and water losses were studied.

In general, the soils of the region are well-leached and very low in organic matter and fertility components. As a rule, they are acid in reaction but responsive to approved soil amendments and conservation practices, especially the plowing under of winter and summer legumes. The Texas Agricultural Experiment Station has shown that substantial increases in yields of cotton follow when winter hairy vetch is turned under as a green-manure crop.[3] Thus, a well-balanced land use program should include the practice of periodic turning under of winter and summer legumes where feasible.

Erosion in the Sandy Lands Region is caused for the most part by surface runoff. Wind causes a small amount of erosion during the spring months on open, bare, sandy fields, though this damage is of small consequence in comparison with the amount of damage resulting from rainfall. Studies of the relationship of rainfall to soil losses on the control plots show that soil type, length and degree of slope, state of cultivation, and surface cover are basic factors directly influencing the rate and amount of runoff and soil loss. The length of slope did not materially affect the amount of surface runoff, but an increase in slope length increased the soil loss resulting from the runoff. In general the same was true of the degree of slope—with increase in degree of slope there was very little difference in total amount of surface runoff but a very pronounced increase in soil loss from areas under cultivation. This did not hold true for well-sodded Bermuda grass areas, which indicates rather definitely that the kind of crop to be grown determines largely the degree of slope which may be used without excessive soil losses. Vegetative cover was shown to be effective in reducing runoff and especially soil loss under the same conditions as to soil type, slope, and rainfall. The degree of control obtained with vegetal cover was dependent upon the type of vegetation used, the season of the year, and the length of time it occupied the land.

There is a lack of adequate power and farm machinery in the region; this has an important bearing on conservation farming. For example, few farmers have equipment to plant or harvest the close-growing crops most suitable for erosion control. Many do not have the horse or tractor power necessary for proper terrace construction. This condition, although it is of an economic nature, seriously hinders the application of many otherwise desirable erosion-control or land use methods. Its solution must be attained, at least in some degree, before any conservation or land use program can be successfully applied.

The protection of cultivated land includes two basic conservation measures, namely, the retiring from cultivation of as many fields having a land slope exceeding 10 percent as is economically practicable and the adequate terracing of the remaining fields.

Experience has shown that many of the steep areas can be profitably utilized as pasture by periodic cultivation and mowing. In some parts of the region, however, it will probably be more profitable to use these areas for the production of forest products. On the more gently sloping cultivated areas within the region, terraces are the first requisite to successful and continued land use. They should be utilized as a base for the adoption of additional erosion-control measures, such as the plowing under of leguminous green-manure crops, strip cropping, and

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[3] REYNOLDS, E. B. WINTER LEGUMES AS SOIL-IMPROVING CROPS FOR COTTON. Tex. Agr. Expt. Sta. Prog. Rpt. 716, 2 pp. 1941. [Processed.]

crop rotations. While it has been shown that these measures, when used alone, tend to reduce soil losses, they cannot be relied on to protect the land at all seasons of the year. In contrast to this, properly constructed terraces will provide a certain degree of protection at all times. Thus, when these measures are wisely coordinated, soil losses are reduced to a minimum and the productive capacity of the soil is increased.

Many diverse characteristics of the region are adverse to a conservational agriculture. For that reason, the application of these recommendations to the whole of the region will require many years of persistent efforts on the part of farm leaders, agricultural workers, and civic bodies. However, once this application is accomplished, much will have been done not only in the way of solving land use problems, but in combating the other agricultural and economic ills associated with land depletion.

The average monthly rainfall distribution for the period of record shows sufficient rainfall throughout the year to produce erosion during any month on unprotected land. Sixty percent of the total soil loss for the period of record was caused by 10 percent of the storms causing soil loss. One or more of these storms occurred during each month except August and September. The period of greatest frequency was during May, June, and July. A single rainstorm of high intensity may remove as much soil as is lost during the entire year from all other storms. An annual average of 2.2 storms of disastrous nature occurred during the 10-year period, but the number for any individual year varied from none to as many as 6. This type of storm has proved to be the cause of the major soil erosion problem of the area. It is against these storms that methods of erosion control should be designed and rated for efficiency. Various supplemental erosion-control measures including contour tillage, cover crops, frequent cultivation, and alternate strips of erosion-resistant crops have all decreased erosion. They have been effective during light storms but have not furnished adequate protection during the critical storms.

The results from 10 years' experimentation at the station have shown that erosion control can be obtained on erodible lands of the region if they are placed under permanent cover of grass or forest. Sloping, intensively cultivated fields, on the other hand, require not only the use of improved rotations and protective winter cover crops but the additional support of terraces. This condition will hold true as long as the prevailing agriculture of the region remains primarily one of growing cotton, corn, and truck crops that require intensive cultivation, which is conducive to soil erosion.

The need for terracing and terrace maintenance in the area will make the progress of erosion control slower than if purely vegetative control measures could be used.

Subsoils erode more rapidly than the normal topsoils when planted to clean-tilled crops. As the soil becomes thinner the rate of erosion increases, which indicates the need for more intense erosion-control measures on the thinner soils. The Nacogdoches soil is less erodible than the Kirvin series under the same crop and cultural treatments and as a general rule is more productive.

Increasing the slope gradient from 8.75 to 16.5 percent increased the soil loss 2½ times. The kind of crop to be grown determines largely the degree of slope which may be used without excessive soil losses. In general, the utilization of steep slopes should be confined to perennial crops having a high degree of erosion resistance.

Bermuda grass and native hardwood forest have been outstanding in decreasing runoff and soil losses to negligible quantities. No attempts were made to separate or evaluate the contributing factors of canopy interception, infiltration, and soil structural changes. The erosion resistance of well-established grass or forest cover is sufficient to provide adequate protection under a wide range of slope factors, rainfall characteristics, and soil types.

Annual burning of the surface litter on a wooded plot increased runoff and soil losses over those from the plot not burned. None of the losses from the unburned plot was of a serious nature, however.

A crop rotation of cotton, sorghum, and cowpeas with a winter cover crop of vetch showed a marked decrease in soil and water losses as compared with those from continuous cotton. Yields of cotton in the rotation were equal to those from plots of continuous cotton treated with 400 pounds of 4-8-4 commercial fertilizer per acre. The rotation received only 100 pounds superphosphate per acre, applied to the vetch at time of planting.

The application of organic matter in the form of manure, compost, and oak leaves reduced soil losses; but the beneficial effects, including increased yields, were confined largely to the first year of application.

The effects from fall seedbed preparation for winter cover crops resulted in some years in an increase in soil loss before the cover crop had made a protective growth.

Complete control of erosion was not obtained from contour tillage, crop rotations, winter cover crops, or strip cropping alone or in combination, although marked reductions in soil losses were obtained as compared with those on the check area.

Strip cropping reduced soil losses but did not furnish protection adequate for continued cropping of the field. The crop grown and the width and location of the strip are important factors in the successful use of strip cropping. When used in combination with terraces, strip cropping helped to reduce soil loss where the strip was located immediately above and including the terrace channel.

Soil losses from terraces having grades exceeding 3 inches per 100 feet were excessive. Terraces occupying fields having a deep, porous soil may be laid out with less grade than those on badly eroded fields having an impervious subsoil, and open-end, level terraces may be used on gentle, well-drained slopes where the soil has an exceptionally high infiltration rate. Much care, however, should be exercised in their construction and maintenance. Closed-end, level terraces should not be used, owing to the high intensities of the rainfall of the region.

Interterrace erosion in the form of rills or small gullies became excessive when the vertical-interval spacing of the terraces exceed 4 feet. The 3- and 4-foot spacings on the experimental areas gave the most satisfactory results.

Per-acre soil losses did not increase with an increase in terrace length. Long terraces, however, require a greater channel capacity than shorter terraces. In general, length of terrace should be governed by the location of a suitable outlet for the terrace channels.

Brush and woven-wire dams performed satisfactorily where the height of drop did not exceed 2 feet. Pole dams up to 4 feet in height gave satisfactory performance and were more durable than brush or woven wire. In general, vegetation, including sod-bag dams, was not found satisfactory for use in active gullies.

Considerable difficulty was experienced in mowing over contour backfurrows in pastures. Since mowing is one of the first essentials to good pasture management, this difficulty offsets any benefit derived from the backfurrows.

In view of the results obtained from a decade of investigational work, certain basic land use recommendations may be made only when these results are carefully adapted to the particular conditions and characteristics of the region.

Owing to the widely diversified agriculture of the region, its small farms, and the character of the rainfall, any land use or conservation program adopted will have to possess sufficient flexibility to meet the particular requirements of the individual farm operator if it is to obtain any degree of success. There is little hope of changing the basic system of agriculture in the region as long as the present economic system prevails, nor is such a change desirable. Localized modifications of the agricultural system have been observed in different parts of the area during the period of experimentation, but have not been of sufficient extent to warrant a change of recommended land use practices. The production of fruit and vegetable crops together with dairy and poultry products enables the average farmer to attain a high degree of self-sufficiency. This is an asset of almost inestimable value to an erosion-control or land use program. The growing of fruit and vegetable crops, however, requires intensive cultivation. This subjects the land on which these crops are grown to serious erosion unless appropriate conservation measures are applied.

And finally, a wise land use program for the problem area calls for retiring the steeper slopes from cultivation, terracing the more gently sloping cultivated areas, and adopting appropriate and effective agronomic practices for the terraced fields in order to maintain their productivity and to further protect the soil from erosion.

INTRODUCTION

This bulletin is one of a series of 10 reports designed to cover the first decade of experimental work at each of the 10 original soil erosion stations established with funds appropriated by the Congress and carried in the appropriations for the United States Department of Agriculture.

On December 18, 1928, the Buchanan Amendment to the Agricultural Appropriation Bill for the fiscal year 1930, appropriating $160,000 for soil-erosion investigations, was adopted by the House of Representatives.

As a result of this legislation, plans were developed for the establishment in various parts of the country of experimental work on lands representative of large problem areas undergoing erosion. Eventually, 10 experiment stations were organized to serve the areas (*1*), (*2*), (*3*), (*4*), (*5*).[4] Their location is shown on the accompanying map (fig. 1).

The research program of the Soil and Water Conservation Experiment Station near Tyler, Tex. was established to obtain information on the causes and effects of erosion and to develop measures for its control in the Texas-Arkansas-Louisiana Sandy Lands Region. This report

[4] Italic numbers in parentheses refer to Literature Cited, p. 53

is a presentation of the results of the investigations of the Tyler station from 1931 to 1940.

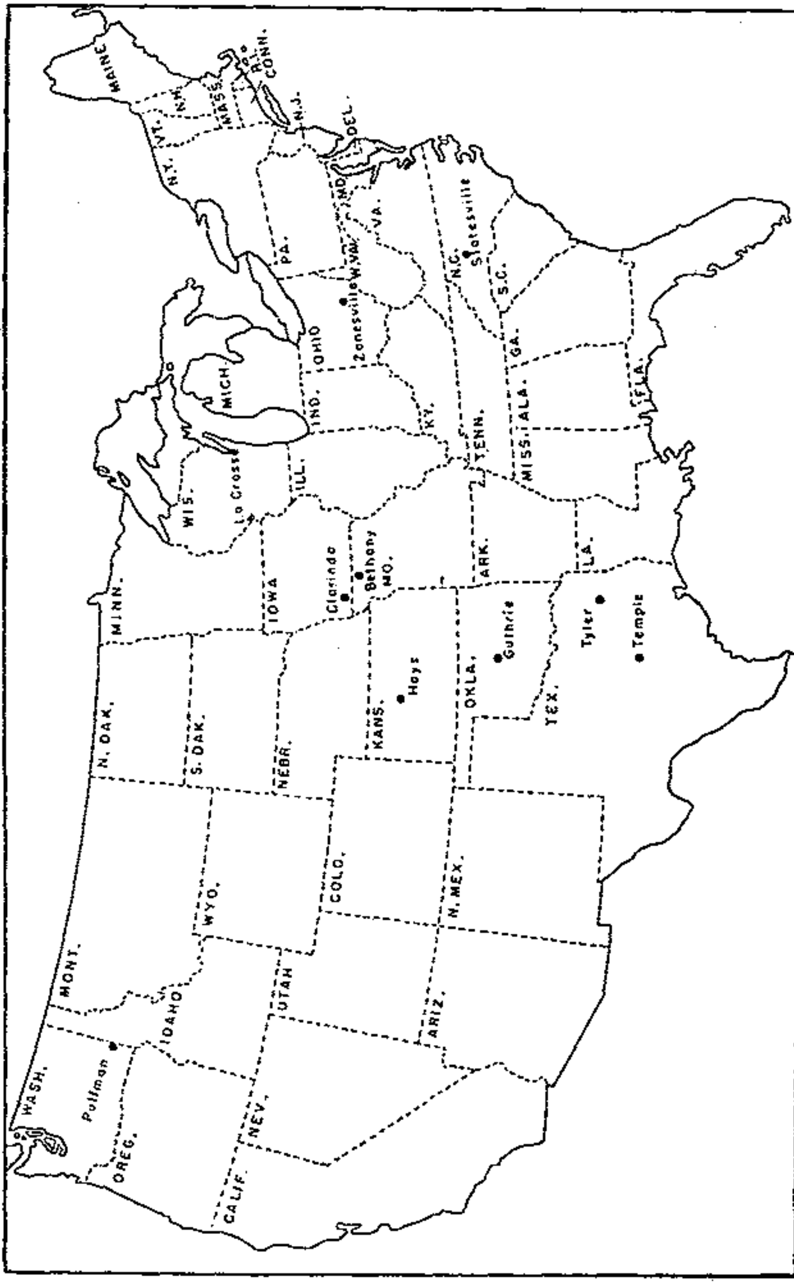

FIGURE 1.—Map of the United States showing location of 10 soil conservation experiment stations.

The station, since its establishment, has been working under a cooperative agreement with the Texas Agricultural Experiment Station. It is located and operated as a part of Texas Substation No. 2, which is 10 miles northwest of Tyler, Smith County, on United States Highway No. 69.

The chief aims of the soil-and water-conservation studies at the Tyler station are to establish ratings on soil and water losses for the problem area, to develop better methods of conserving the topsoil, and to maintain and improve its productivity. The principal work to date has been the measuring of surface runoff and soil losses in runoff from control plots, terraces, and fields under different conditions. The effect on soil and water losses of such factors as vegetative cover, length and degree of slope, slope characteristics, crop rotations with winter and summer green-manure crops, strip cropping practices, and terracing (including grade, spacing, and length) is being studied.

Some of the studies, which were strictly exploratory, were set up without replications and conducted only for a short period before being terminated or modified. These studies have served as a basis for the development of an erosion-control program applicable to this area, and some of them may continue to furnish useful information for future improvement of erosion-control methods. Many of the findings of the station have been adopted throughout the area with certain modifications to fit special conditions. Methods of establishing and improving the protective cover of permanent pastures, the effectiveness of certain soil-conserving and soil-improving green-manure crops, and the most desirable terrace characteristics for the area are examples of the types of information obtained during the time the station has been in operation. Strip cropping, contour tillage, and other conservation measures have been tested on field-size scale to determine the conditions under which they are most effective when applied to the soils of this region.

THE PROBLEM AREA

Nature of the Area

The area served by the Tyler Soil and Water Conservation Experiment Station is the Interior West Gulf Coastal Plain. There are approximately 48,000,000 acres in the area located in eastern Texas, northwestern Louisiana, southwestern Arkansas, and a comparatively narrow strip which extends from the Arkansas line to the vicinity of Ardmore in southeastern Oklahoma. Approximately 26,000,000 acres of this area lie within, or partly within, 74 counties of eastern Texas. The region as a whole is one of the most seriously eroded in the United States (fig 2).

Farms are small; fields are irregularly shaped; equipment used is small, and comparatively simple; and relatively large quantities of commercial fertilizers are used. A basic cropping system is followed, in which cotton and corn are supplemented in various parts of the area with a wide variety of specialty crops—mainly fruits and vegetables. Other crops grown rather generally are cowpeas, sweetpotatoes, watermelons, peanuts, and sorghums.

There are some fairly large bodies of commercial timber in the area. A small amount of timber is found on the majority of the farms, which supplements the farm income through the sale of pulpwood, cross ties, light poles, fence posts, and firewood.

The most important problem of the area is the conservation of the soil and the maintenance of its fertility. The topsoils, in general, are

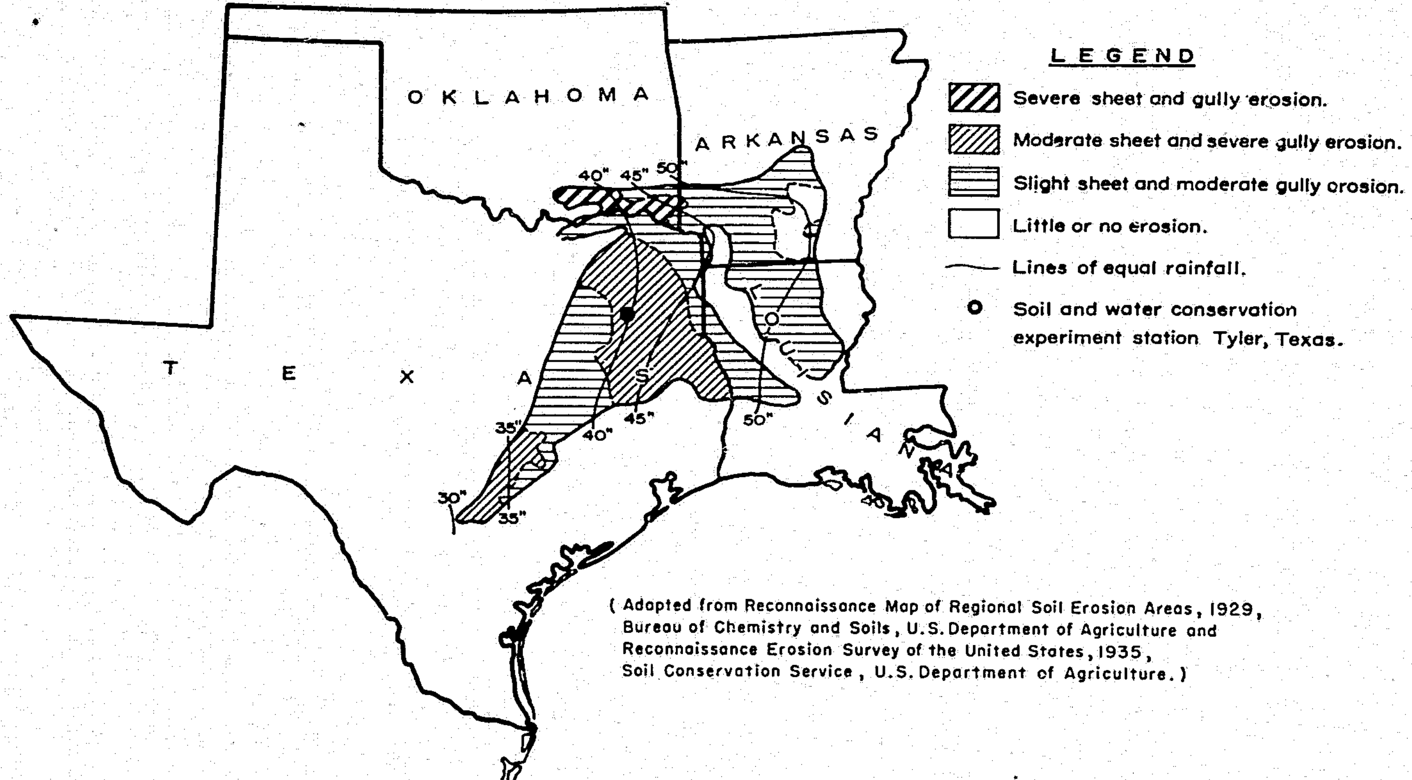

FIGURE 2.—Distribution of erosion and rainfall in Arkansas-Louisiana-East Texas Sandy Lands Region.

sandy loams underlain with clay or sandy clay subsoils. As a rule they are very erodible, especially during long or intense rains. The tendency of these soils to bake and crust over after hard rains during spring and summer months results in high runoff from subsequent rains. The problem of conserving the topsoil is further complicated by erratic distribution and high intensity of the rainfall. There are periods of excessive rainfall when it is necessary to allow some of the precipitation to escape as runoff. These are usually followed by periods of insufficient rainfall, which often occur during the critical crop-producing time. It is believed that the solution of the drought problem must necessarily be arrived at by devising some means whereby a part of the surplus rainfall may be stored in the soil to be used during periods of light rainfall.

Soils.—Carter (7), pp. 35–36 describes the soils of the problem area of the East Texas timber country as follows:

The soils of the East Texas Timber Country consist mainly of fine sands and fine sandy loams. The surface soils, mostly light in color (though some are red), as a rule, are underlain by subsoils that are heavier than the surface layers. The surface soils are in most places of two distinct layers, the upper, containing only a small amount of organic matter, grading below into a subsurface layer of similar texture. In virgin areas the organic layer is but two or three inches thick, but with cultivation this is increased to a thickness of 6 inches or more. The color of the organic layer (where not red) is brown or gray, while the subsurface, corresponding largely to the color of the subsoil beneath, is mostly red, brown, yellow, or gray, or shades of these colors. The subsoils, mostly of clay or sandy clay, differ greatly in color and structure and on their characteristics is based the differentiation of the soils into series groups. As a rule, all of the soil and subsoil layers are of acid reaction. The surface and subsoil layers merge together beneath many of the soils, but in others there is a sharp line of separation between the surface soil and subsoil layers.

The soils have been developed mostly from beds of noncalcareous clay, sandy clay, clay shale, or sand. They reflect, in their developed characteristics, the influences of a warm, moist, climate and the vegetative cover of trees which contribute but little organic matter. The results of leaching and erosion, due to high rainfall, are indicated in the developed deep beds of fine sand on the nearly flat high areas, and in the variable thickness of soil and subsoil layers on slopes of different gradients where, in places, erosion has removed all or part of the soil layers before they have become thoroughly developed. Where free underdrainage occurs, red and yellow colors become established in the subsoils, but where drainage is very slow gray color predominates. Little or no true soil development has taken place in the soil materials comprising the alluvial soils of the stream-bottom lands. These consist of soil materials washed chiefly from the local upland soils and are periodically receiving fresh deposits from the same source. On some relatively small flat areas comprising old stream terraces the ancient alluvium has been developed into soils which have characteristics very similar to those of the higher upland soils developed from older parent materials.

The upland soils are the most extensive, probably covering 85 percent of the region. On the basis of pronounced characteristics of the subsoils the soils are of two divisions: (1) the soils having friable, crumbly, permeable subsoils, and (2) soils with dense very heavy subsoils. While soils of each division occur extensively in different sections, neither occupies large areas exclusively, and in many sections they are to be found in many small and large bodies in close association. The soils with the friable subsoils usually have better drainage, respond more favorably to methods of soil improvement and fertilization, and, therefore, are on the whole more satisfactory for the production of farm crops.

The principal soils of the station are described more in detail in table 1.

TABLE 1.—*Principal soils on the station farm*

Soil groups series	Topsoil	Subsoil	Substratum (parent material)
Kirvin	Light brown to grayish or slightly reddish.	Red, some gray mottling in lower part, slowly permeable.	Clay or sandy clay.
Bowie	Gray to light brown; yellow subsurface.	Yellow mottled with gray and red; permeable.	Clay or sandy clay.
Nacogdoches	Red; ironstone fragments in many places.	Red; slowly permeable.	Clay or sandy clay.

In general, the topography is moderately rolling to hilly. The elevations range from a minimum of approximately 50 feet to a maximum of about 600 feet above sea level. Toward the Gulf, the relief becomes milder with an occasional almost level area. In detail, surveys indicate that about 30 percent of the area has a gradient of less than 2 percent, approximately 60 percent has slopes ranging from 2 to 8 percent, and 10 percent has slopes exceeding 8 percent. In most instances, a high percentage of the open areas with a gradient above 8 percent is in poor physical condition and is badly gullied.

Climate.—Meteorological records have been secured over a period of 36 years, 1905–41, by Texas Substation No. 2 near Tyler and records maintained during the progress of the experiments. The annual rainfall in the area served by the station ranges from 30 inches in the extreme southwest part of the area to as much as 50 inches in the eastern part. The Soil and Water Conservation Experiment Station is located in the western part of the area in the 40-inch rainfall zone. The average rainfall of the different rainfall zones of the region is indicated in figure 2.

The average rainfall for a period of 36 years as recorded by the Texas Substation No. 2 is 42.96 inches, and the average rainfall recorded during the period covered by this report, 1931–40, is 40.66 inches. Average annual rainfall and its distribution by months are given in table 28, Appendix.

Although the area is within the humid belt, the rainfall is erratic throughout the year. The storms with high intensities occur most frequently during the spring and early summer months, when the farming systems of the area furnish the least amount of protection and the soil conditions are the most vulnerable to erosion. The late-fall and winter rains are usually of long duration and low to moderate intensities.

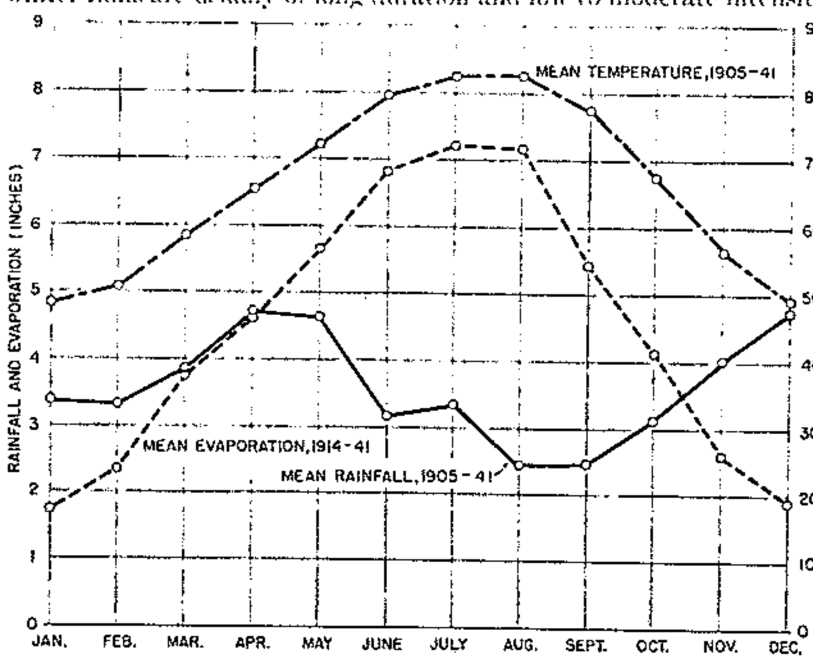

FIGURE 3.—Mean monthly rainfall, evaporation, and temperature as recorded by the Texas Agricultural Experiment Station, Substation No. 2.

The length of growing season, or frost-free period, usually ranges from 200 to 250 days. The winters are open, and the ground is rarely frozen continuously for more than a few days. The summers are hot, with occasional droughts as long as 6 to 8 weeks, which cause considerable damage to the growing crops. The mean monthly fluctuations in rainfall, evaporation, and temperature are shown in figure 3. Average annual and monthly mean temperatures are given in table 29, Appendix.

Erosion and Runoff History

Erosion in the area is described by Bennett (*4 pp. 631–633*) as follows:

About 35 per cent of the area is in cultivation; 7 per cent is idle; 13 per cent is in pasture; and 45 per cent in timber. Of the timbered area, a considerable proportion, particularly in Arkansas, Louisiana, and northeast Texas, was cultivated at one time, the present stand of trees consisting of second-growth pine. A reconnaissance erosion survey indicates that about 45 per cent, or some 7 million acres, of the area now in cultivation has suffered seriously from erosion, and about 6 per cent, or a million acres, has suffered severely. Of the second-growth pine areas, much more of the land has suffered severely from erosion. The low figure for severely eroded land is partly accounted for by the comparatively large area in the southerly border zone that has never been plowed, together with a rather large area of flat land in this section. Over a considerable proportion of the more rolling part of this problem area, the percentage of severely eroded land, as well as that subject to moderate erosion and to slight erosion, is much higher. The most erodible of the extensive farm soils is the Kirvin sandy loam (or fine sandy loam). On this soil, which predominates in northeastern Texas and adjacent portions of Louisiana and Arkansas, it is generally unsafe to cultivate slopes steeper than about 8 per cent.

THE STATION

The Soil and Water Conservation Experiment Station was established in 1930 in cooperation with the Texas Agricultural Experiment Station. The conservation experiments are conducted on a part of the 455-acre tract owned by the Texas Agricultural Experiment Station and located 10 miles northwest of Tyler on United States Highway No. 69. Figures 4 and 5 show the station layout and a soil and erosion survey map of the farm.

The farm was selected for experimental work as being representative of the Texas-Arkansas-Louisiana Sandy Lands Region. Kirvin is the predominant soil on the tract, although seven other soil series typical of the region occur. These are Nacogdoches, Bowie, Hannahatchie, Susquehanna, Norfolk, Bibb, and Orangeburg.

The topography of the station farm is similar to that of the general area except that the farm has no typical bottom land and only a few gently sloping areas. Slopes range from 2 to 20 percent, though most of the areas in cultivation are on 4- to 10-percent slopes. Elevation of the station ranges from 447 to 606 feet. Elevation of benchmark No. 7, located near the office, is 504.46 feet datum mean sea level. The station is located on a divide between the Sabine and Neches Rivers. The northwest portion of the farm is drained by the Neches, the remainder is in the watershed of the Sabine.

At the time of the establishment of the experiment station, the most serious gully erosion was found in fields C and D, although these areas had been under the plow only approximately 25 years. Many areas of the farm had previously been cultivated but were retired to pasture before the time of their assignment for erosion investigations. Some of the fields had been cultivated intermittently for a period of about 85 years, although there were some small areas of virgin forest. In general, most of the cultivated fields had lost from 50 to 75 percent of their topsoil. The major portion of the farm had been operated by tenants for a number of years, and had been misused with the result that it was in

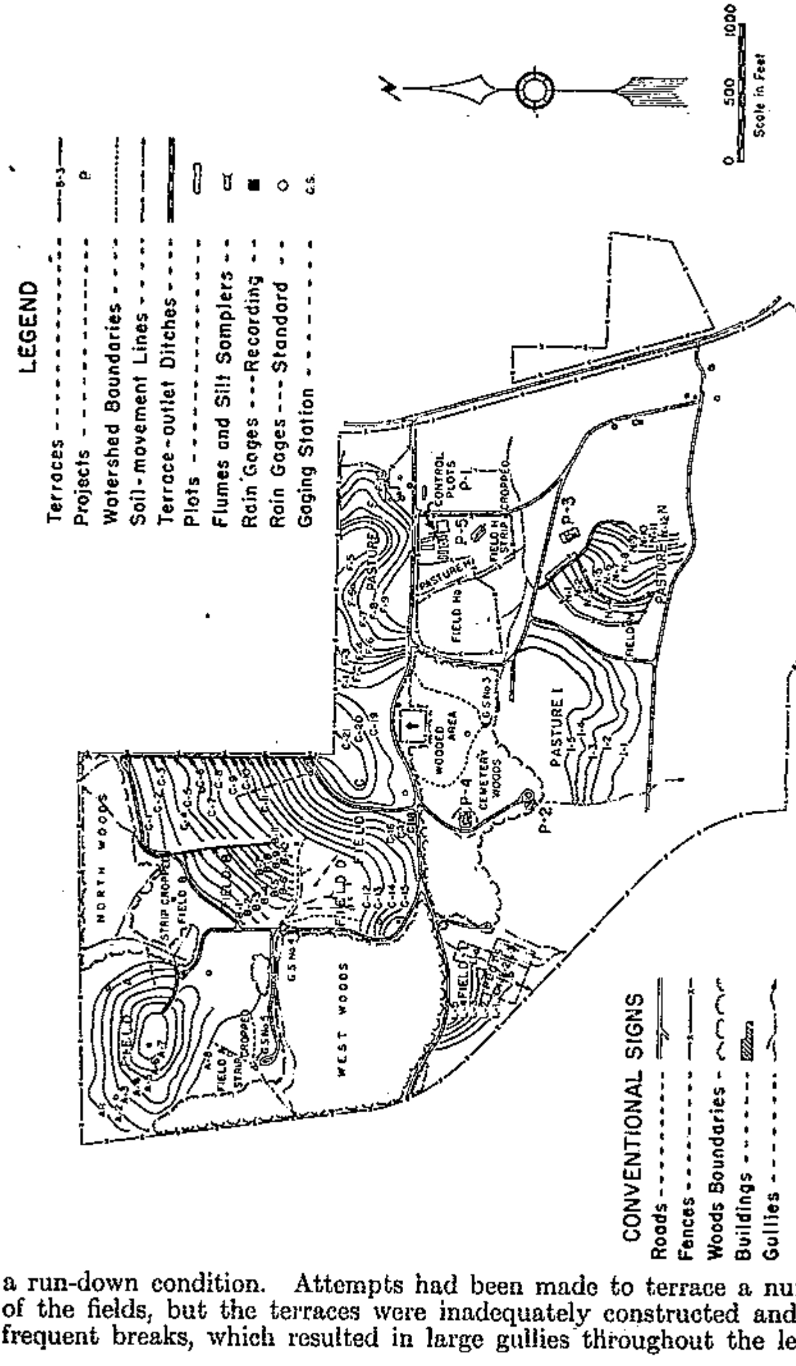

Figure 4.—Map of the Soil and Water Conservation Experiment Station and the Texas Agricultural Experiment Substation No. 2, Tyler, Tex.

a run-down condition. Attempts had been made to terrace a number of the fields, but the terraces were inadequately constructed and had frequent breaks, which resulted in large gullies throughout the length of the fields. A few of the terraces on the more moderately sloping fields had no evidence of breaks. The grade of these terraces, however, ranged from 12 to 18 inches per 100 feet and resulted in serious erosion along the terrace channel.

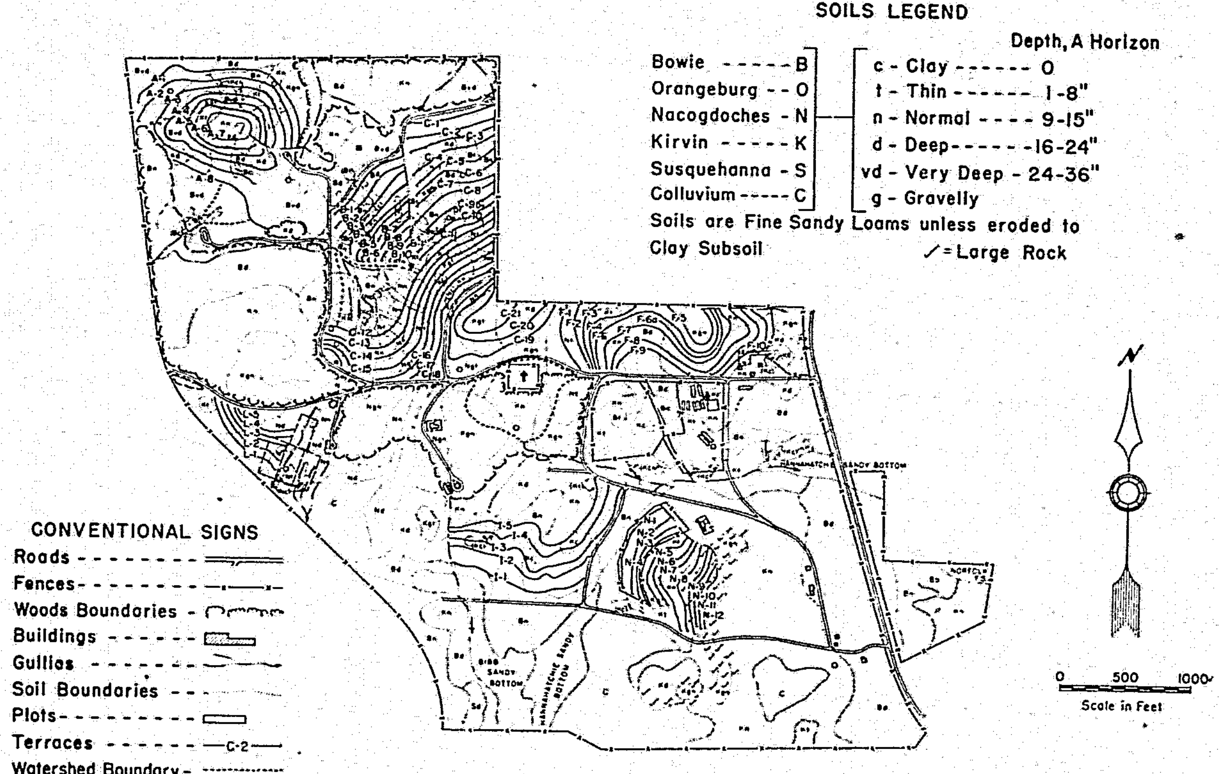

FIGURE 5.—Soil map of the Soil and Water Conservation Experiment Station and The Texas Agricultural Experiment Substation No. 2, Tyler, Tex.

PURPOSE AND PLAN OF EXPERIMENTS

The purpose of the experiments is to investigate the causes and to secure quantitative measurements of the soil and water losses on experimental areas.

The principal work of the station has been the measuring of surface runoff and soil loss in runoff from control plots, terraces, and fields under experimental treatment. The effects on soil and water losses of such factors as vegetative cover, slope length, degree of slope, soil type, arrangement of crops, crop rotations with winter cover crops, and terracing including grade, spacing, and length have been included in the studies. A detailed description of the various installations follows.

Control-plot Installations

PLOT DESCRIPTIONS

The control-plot experiments consist of 12 plots on Kirvin fine sandy loam located on a slope of 8.75 percent (fig. 6 *A*), 3 plots on Kirvin fine sandy loam with a 16.5-percent slope (fig. 6 *B*), 4 plots on a Nacogdoches fine sandy loam with a 10-percent slope (fig. 7 *A*), and 2 plots on a wooded area of Kirvin fine sandy loam with a 12.5-percent slope (fig. 7 *B*).

The plots on 8.75-percent slope were established in October 1930. The plots on 12.5-percent, 16.5-percent, and 10-percent slopes were established in July 1931.

All of the plots were 6 feet wide and 72.6 feet long except four of the slope-length plots, of which three are 36.3 feet long and one is 145.2 feet long. The plots are separated by sheet-metal dividers. All runoff from the plots is caught in concrete basins and sheet-metal tanks.

All planting and tillage operations are on the contour and are performed in such a way that field conditions are simulated as nearly as possible. The rates of seedings, spacings, and fertilizer treatments are in accordance with the Texas Experiment Station's recommendation for the area.

The treatments and size of plots on the different soils and slopes were as follows:

Kirvin 8.75-percent slope.—Plot 1 (continuous cotton; slope length 36.3 feet; one two-hundredths of an acre) was fertilized with 4–8–4 fertilizer at the rate of 400 pounds per acre from 1935 to 1940. Plot 2 (continuous cotton; slope length 145.2 feet; one-fiftieth of an acre) was fertilized with 4–8–4 fertilizer at the rate of 400 pounds per acre from 1935 to 1940. Plot 3 (continuous cotton; slope length 72.6 feet; one-hundredth of an acre) was fertilized at the rate of 400 pounds of 4–8–4 fertilizer per acre from 1935 to 1940. Plot 4 (continuous cotton; slope length 72.6 feet; one-hundredth of an acre) was fertilized with 400 pounds of 4–12–4 fertilizer per acre from 1931 to 1934 and from 1935 to 1940 at the rate of 400 pounds of 4–8–4. In 1935 ridge culture replaced flat culture. From 1936–40 flat culture was followed.

Plots 5, 6, and 7 (slope length 72.6 feet; one-hundredth of an acre) were in a rotation of cotton, corn, and lespedeza with small-grain winter cover crop. In 1935 corn was fertilized with 100 pounds per acre of sulphate of ammonia, lespedeza with 200 pounds per acre of superphosphate, and cotton with 400 pounds of 4–8–4. For 1936–40 the rotation was cowpeas, cotton, and sorghum with a winter cover crop of vetch. The vetch received 100 pounds of superphosphate per acre at time of seeding.

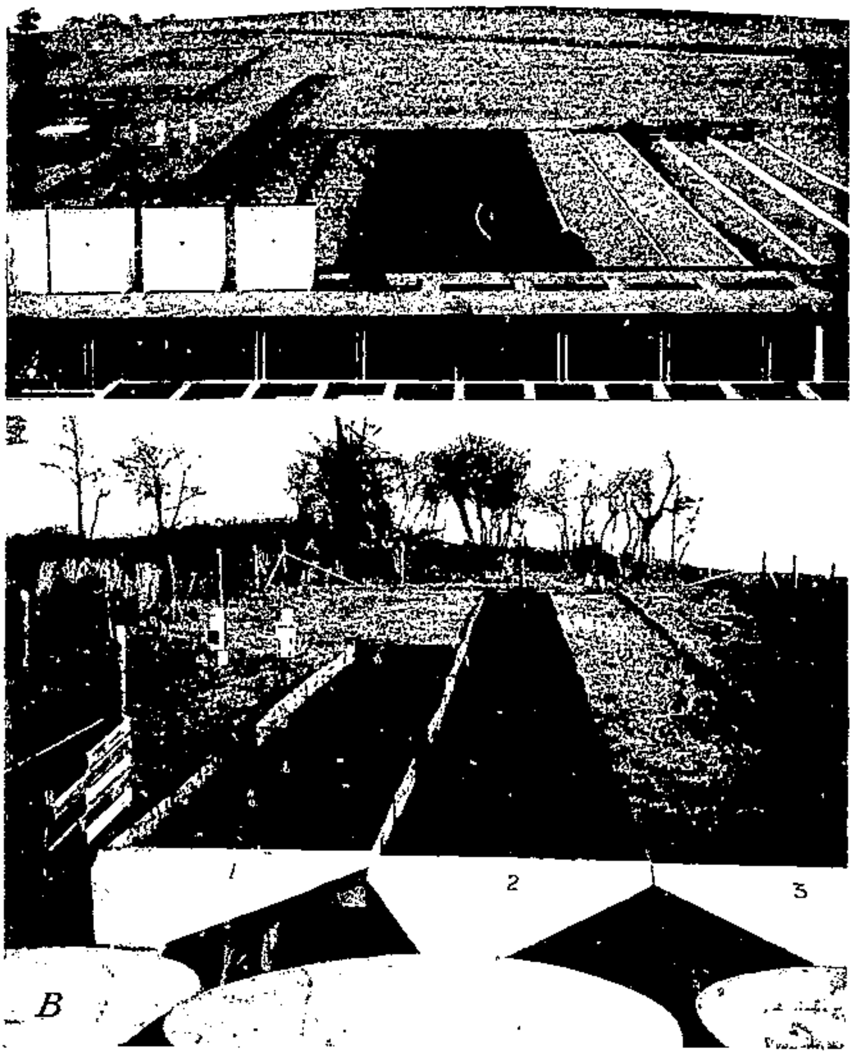

FIGURE 6.—*A*, Kirvin main control plots, 8.75-percent slope. Plots numbered from left to right. *B*, Kirvin control plots, 16.5-percent slope.

Plot 8 (slope length 72.6 feet; one-hundredth of an acre) was in continuous Bermuda grass. Plot 9 (slope length 72.6 feet; one-hundredth of an acre) was in bare, hard fallow, 1931–34; 1935–40, cultivated fallow.

Plot 10 (slope length 72.6 feet; one-hundredth of an acre) was in small, grain winter cover crop. In 1931–34, 4–12–4 fertilizer was applied at

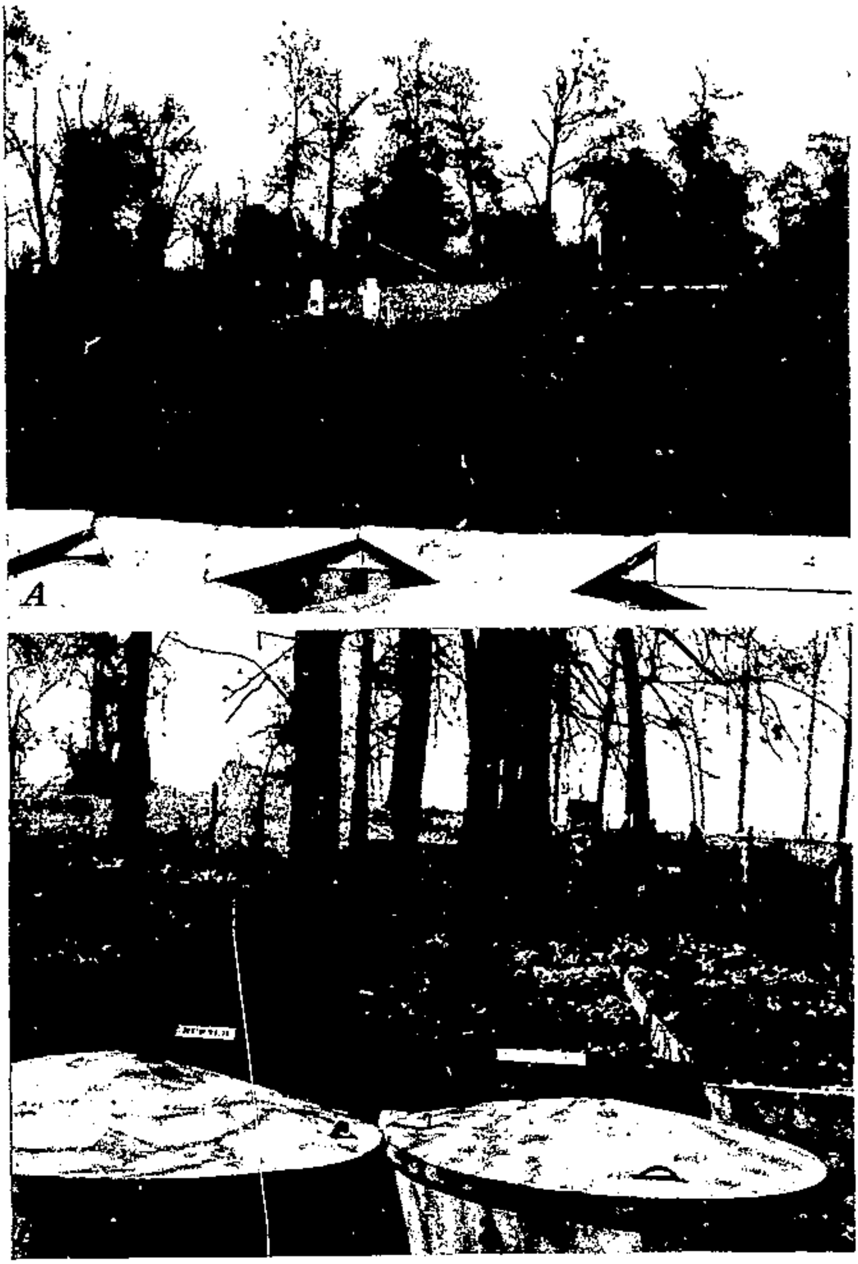

FIGURE 7.—*A*, Nacogdoches control plots, 10-percent slope; *B*, wooded control plots of Kirvin fine sandy loam, 12.5-percent slope.

the rate of 400 pounds per acre. One hundred pounds of superphosphate per acre was applied to winter cover crop of vetch, 1935–40. Plot 11 (slope length 72.6 feet; one-hundredth of an acre) was in continuous cotton and desurfaced to subsoil and fertilized with 4–12–4 at the rate of 400 pounds per acre from 1931–1933. From 1934 to 1940 this plot was fertilized with 4–8–4 at the rate of 100 pounds per acre.

Plot 12 (slope length 72.6 feet; one-hundredth acre) was in continuous cotton and desurfaced to subsoil. This plot was treated with 4–8–4 fertilizer at the rate of 400 pounds per acre from 1934 to 1940. In 1935 ridge culture was used, and in 1936–40 flat culture.

Kirvin 12.5-percent slope.—Plot 1 (wooded area; slope length 72.6 feet; one-hundredth acre) was protected from grazing and burned annually. Plot 2 (wooded area; slope length 72.6 feet; one-hundredth acre) was protected from grazing and not burned.

Kirvin 16.5-percent slope.—Plot 1 (slope length 36.3 feet; one two-hundredth acre) and plot 2 (slope length 72.6 feet; one hundredth acre) were treated with 4–8–4 fertilizer at the rate of 400 pounds per acre from 1935–40. Plot 3 (slope length 72.6 feet; one-hundredth of an acre) was in continuous Bermuda grass.

Nacogdoches 10.0-percent slope.—Plot 1 (continuous cotton; slope length 36.3 feet; one two-hundredth acre) and plot 2 (continuous cotton; slope length 72.6 feet, one-hundredth acre) were fertilized at the rate of 400 pounds of 4–8–4 per acre from 1935–40.

Plot 3 (slope length 72.6 feet; one-hundredth acre) was in continuous Bermuda grass. Plot 4 (slope length 72.6 feet; one-hundredth acre) was in continuous cotton and desurfaced to subsoil. This plot was fertilized at the rate of 400 pounds of 4–8–4 per acre from 1935–40.

SOIL SERIES

It is recognized that some of the soils of the area are more erodible under similar cropping treatments than others. Of the two soils under measurement, Kirvin, the predominating series of the area, is the more erodible and Nacogdoches is more fertile and less erodible. The profile of these two soils has been studied in detail in the laboratory, and chemical and physical analyses have been reported elsewhere (*10*, *11*, and *13*). A study was conducted on these two soils under normal topsoil and exposed subsoil conditions. For comparative purposes, the topsoil was removed down to the subsoil to simulate badly eroded conditions on both of these soils. Four plots were used, two of normal topsoil and two of subsoil. The Kirvin plots are located on 8.75-percent slope; whereas, the Nacogdoches plots are located on a 10.0-percent slope. Uniform cropping practices and fertilizer treatments were applied to all the plots.

SOIL MOISTURE STUDIES

For a period of 4 years, 1931–34, moisture studies were made on an adjacent series of plots with the same crops and cultural treatments as control plots. Samples were collected regularly and moisture determinations for specific conditions recorded.

SLOPE LENGTH AND DEGREE

Control plots 1, 2, and 3 on Kirvin 8.75-percent slope with slope lengths of 36.3, 145.2, and 72.6 feet, respectively, were established to measure the effect of slope length when the land is planted to cotton annually. This same treatment was repeated on Kirvin 16.5-percent slope and Nacogdoches 10-percent slope with slope lengths of 36.3 and 72.6 feet, respectively.

Plots 1 and 3 on 8.75-percent Kirvin and plots 1 and 2 on 16.5-percent Kirvin are 36.3 and 72.6 feet long, respectively, and were planted continuously to cotton. All cultural practices and fertilizer treatments are as nearly alike as possible on these four plots. Plots on the 8.75-percent slope were established in 1930, whereas the plots on the 16.5-percent slope were not established until 1932.

STRIP-CROPPING CONTROL PLOTS

Six plots were used in this study, two of which were located on 5.5-percent Bowie and four on 6.5-percent Kirvin.

The treatments and size of plots on the two different soils and slopes were as follows: On Bowie 5.5-percent slope a strip-cropped plot and a check plot were used in this study. The plots were 145.2 feet in length and 20 feet wide, one-fifteenth of an acre in size. The strip-cropped area had two strips 36.3 feet wide in an erosion-resistant crop. It was separated from the check plot by an alleyway, one-half of which was planted to the same crop as the adjoining plot for the purpose of eliminating border effect. The plots were equipped with silt boxes, multislot divisors, and tanks for collecting soil and water sampled.

FIGURE 8.—Group of one-fiftieth acre plots showing alleyways between plots.

A 2-year cropping system was followed in this study, consisting of cotton on the erodible strips alternating with erosion-resistant strips of sorghum interplanted with cowpeas, which were in turn rotated with spring oats.

The erodible strips were planted in cotton followed by fall planting of vetch which was plowed under in the spring as a green-manure crop preceding the next planting of cotton in the spring. The check plot was planted in cotton followed by vetch which was plowed under as a green-manure crop in the spring preceding the planting of cotton. On

Kirvin 6.5-percent slope two strip-cropped plots and two check plots were used in this study. The plots were 72.6 feet in length, 12 feet wide, and one-fiftieth of an acre in size. The strip-cropped areas had two strips 18 feet wide in an erosion-resistant crop (fig. 8). The plots were separated by alleyways and enclosed with 12-inch creosoted boards, 6 inches of which were embedded in the soil to prevent outside water from entering the area under measurement. One-half of the alleyways was planted to the same crops as the adjoining plots for the purpose of eliminating border effect. Soil and water losses were measured with Uhland divisors and tanks.

A 2-year cropping system was followed in this study, consisting of cotton on the erodible strips, alternating with erosion-resistant strips of sorghum interplanted with cowpeas, which in turn were rotated with spring oats. The erodible strips and the check plots were planted to cotton followed by fall planting of vetch which was turned under as a green-manure crop preceding the planting of cotton in the spring.

ORGANIC-MATTER TREATMENTS

Four (one-fiftieth acre) plots located on Kirvin fine sandy loam, 6.5-percent slope, were used in a study of the erosion-resistant effect of organic-matter treatments. The plots had an alleyway between them to eliminate border effect. The plots were enclosed with boards 12 inches wide, 6 inches of which were below the surface of the ground. The measuring equipment consisted of Uhland-type divisors and sample tanks. The treatments were as follows: Plot 1, continuous cotton, no organic matter added; plot 2, continuous cotton, oak leaves spaded under the first year at the rate of 15 tons per acre; plot 3, continuous cotton with compost spaded under the first year at the rate of 10 tons per acre; plot 4, continuous cotton, barnyard manure spaded under the first year at the rate of 10 tons per acre.

During the progress of the experiment, no additional applications of organic matter were made, but an application of a 4–8–4 commercial fertilizer was made at the uniform rate of 400 pounds per acre on all plots at the beginning of the third season.

Field Plot Studies

Two field areas of strip cropping were included in the experiments. One of the areas was a small, unterraced watershed where the eroded material was measured at the bottom of the slope. The other area was a terraced area where the eroded material was collected at the outlet ends of the terraces.

Strip cropping without terraces.—This study was located on a 5-acre field of Bowie fine sandy loam with an average land slope of 5.5 percent. Soil and water losses were measured on a 2.64-acre area by means of a Parshall flume, Bristol recorder, silt box, and Ramser silt sampler. The gullies and washes were plowed in and vegetated with Bermuda grass at the beginning of the study. Fall sown oats were used on the control strips which were 48 feet wide and constituted 50 percent of the area. Cotton was planted on the cultivated strips.

The cropping system of this study consisted of a 2-year rotation of cotton and oats planted in alternating strips. The oats were harvested and the stubble allowed to stand for erosion protection until late summer, at which time the stubble was turned under in preparation for the fall seeding of a vetch cover and green-manure crop to be turned under the following spring preceding the planting of cotton. The erodible strip of cotton after harvesting in the fall was plowed and seeded to oats, which became the control strip. Under this system of strip cropping, an erosive fall rain at the time when both strips are freshly plowed and before the protective crop becomes established, may cause a high soil loss.

Strip cropping with terraces.—In this study, soil and water losses were measured on four terraces. One terrace was used as a check without an erosion-control strip, and the other three had erosion-resistant strips located as follows: below and adjacent to the upper terrace, including the lower side of the terrace ridge; in the middle of the terrace interval; and above and adjacent to the terrace, including the terrace channel. Each terrace was equipped with a Parshall flume, Bristol recorder, silt box, and Ramser silt sampler.

The cropping system followed in this study consisted of a 2-year rotation of corn and cotton on the erodible strips with sorghum and oats on the control filter strips. The sorghum was harvested and the stubble allowed to stand for protection until early spring, when it was plowed under and seeded to spring oats with an application of 300 pounds of 6–9–3 fertilizer per acre applied at the time of seeding the oats. The erodible strips of the 2-year rotation of corn and cotton both had a winter cover and green-manure crop. Vetch followed corn with 100 pounds of superphosphate per acre applied at seeding time. The vetch was plowed under preceding the planting of cotton. Oats followed cotton and were plowed under preceding the planting of corn.

Terraces.—During the winter of 1930–31 approximately 10.5 miles of Mangum type terraces were constructed on the station. Various machines were used for building the terraces and the costs of construction recorded. Terraces used in the principal experiments were constructed with a base width of 25 feet and an effective height of 18 inches.

Studies were made on the effect of length, grade, and vertical interval on soil and water losses from individual terraces. Terraces C–10, C–17, and C–14 were used in the length experiment and were located near the upper reaches of the slope in field C (See fig. 4.) The predominating soil on which the terraces were located was Nacogdoches, interspersed with areas of Kirvin on terraces C–14 and C–17, although small areas of Bowie and Orangeburg occurred on terrace C–10.

Experiments on terrace grade were conducted on both short and long terraces, 700 feet and 1,700 feet in length. The terraces 700 feet long were numbered C–4, C–5, C–6, C–7, and C–10. They were located in field C in the lower portion of the field. Bowie soil predominated with the exception of terrace C–10 on which Nacogdoches was the predominant soil. These soils were interspersed with small areas of Kirvin and Orangeburg although terrace C–7 was mapped in its entirety as Bowie. Terraces C–12 and C–13 were used as the long terraces in the experiment on grade. They occupied the upper central portion of the slope in field C on Nacogdoches soil with almost equal areas of Kirvin.

The experiment to determine the most satisfactory vertical interval of terraces was also located in field C and included both long and short terraces. Terraces C–8, C–9, C–10, and C–11 were the 700-foot erraces used in this study. Terraces C–13, C–14, and C–15 were 1,700 feet long and were located near the upper part of the field. The shorter terraces were near the lower central portion of the field. Soils were generally mixed, as in the other experiments, with Nacogdoches predominating on the long terraces and Bowie, Orangeburg, and Nacogdoches occupying the major portions of the shorter terraces.

Other terrace experiments included the observation of closed-end level terraces encircling a knoll, the measurement of soil and water losses, and the observation of the performance of an open-end, level terrace 2,300 feet in length, and the measurement and observation of the performance of terraces with different vertical intervals on pasture and cultivated land.

In all cases the cropping system followed was the same for all the terraced areas of a particular experiment.

Owing to the extent of the areas, it was not possible to retain all of the runoff occurring from terraced areas as was done with the control plots. Consequently, measurements of soil and water losses at the end of terraces on these areas were made by the use of Parshall flume and liquid level recorder with a silt box, or settling basin, placed below the flume. A Ramser silt sampler was used to obtain a sample of the runoff passing over the weir end of the silt box. Determinations of the soil content of the runoff were then made from the sample obtained (fig. 9).

FIGURE 9.—Battery of silt samplers used for measuring soil and water losses at the ends of individual terrace channels.

Soil movement studies.—Soil movement studies to determine the rate of movement of soil down the slope and to detect the formation of washes and determine their rate of growth were made on terraced areas and watersheds. Concrete embedded steel posts were set to serve as benchmarks on the permanent soil movement lines. Measurements were made from these fixed points and elevations taken at intervals of one foot along an established line. In order to decrease the influence of cultural treatments, these measurements were taken during the late winter months after the ground had settled.

Watershed Studies

Description of the areas.—A part of the station's experimental work is the measurement of soil and water losses from small agricultural watersheds subjected to different land uses. The areas used in this study consisted of three small watersheds, each equipped with a Parshall flume, a liquid level recorder, a silt box, and a Ramser silt sampler. For record purposes the watersheds were designated as gaging stations Nos. 3, 4, and 5. No. 3 was a wooded watershed of 7.94 acres with an average land slope of 7.5 percent. The predominating soil was Kirvin fine sandy loam with some areas of Nacogdoches. No. 4 was an unterraced, contour-cultivated watershed of 6.05 acres with an average land slope of 7.5 percent. The predominating soil was Bowie fine sandy loam associated with small areas of Kirvin and Nacogdoches. No. 5 was an unterraced, contour-cultivated, strip-cropped area of 2.64 acres, located on 5.5-percent Bowie fine sandy loam.

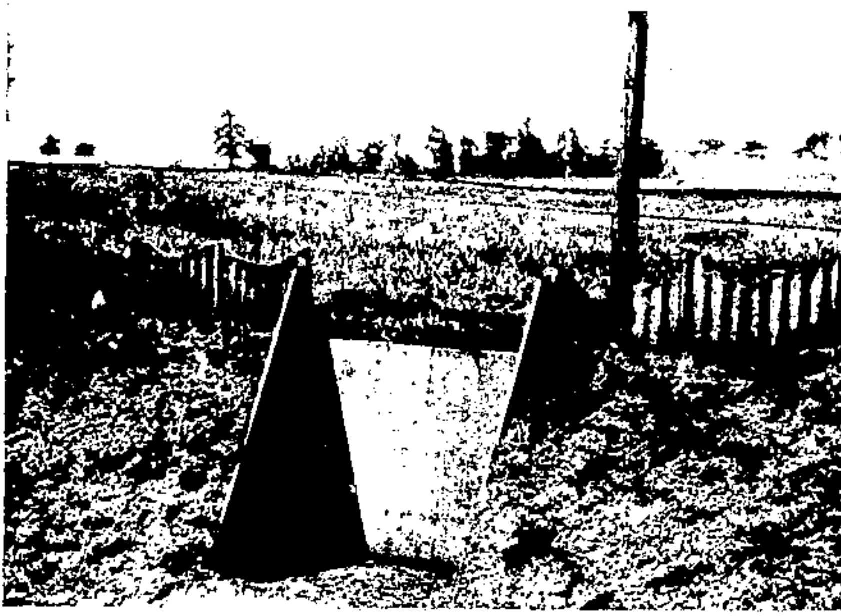

FIGURE 10. - Patented sheet-metal dam used for terrace outlet control.

The cropping treatments on the two cultivated areas were as follows: On the unterraced, contour-cultivated watershed, the cropping system consisted of a 3-year rotation of corn, cotton, and oats. The corn was followed by a crop of fall-planted vetch which was turned under in the spring as a green-manure crop preceding the planting of cotton. The cotton was followed by a fall-planted crop of oats which was harvested and followed by cowpeas during the summer. The pea vines, volunteer oats, and crabgrass following the peas furnished the winter protection. This protective cover remained on the ground and was turned under in the early spring preceding the planting of corn.

The strip-cropped, unterraced watershed had a 2-year rotation of cotton and oats grown in alternating strips 48 feet wide. The cotton strips were planted in the fall to oats which were harvested in the early summer and the stubble allowed to remain as a summer protective strip. The oats strips were planted in the fall to vetch which was turned under in the spring as a green-manure crop preceding the planting of cotton.

The wooded watershed was fenced, protected from burning, and during the early years of the period of record was grazed occasionally during the spring months. The cover consisted of a mixed growth of native hardwood trees of the black-jack and post-oak types and was considered a fair representation of forest cover for the area.

Gully and terrace outlet control.—The large number of gullies on the station land afforded an excellent opportunity for the study of different methods of gully control; consequently, considerable time and energy was devoted to this phase of the work during the early years of the station. Various materials were used in the construction of mechanical dams or structures, including brush, poles or logs, woven wire, loose rock, concrete, and rock masonry. Patented sheet-metal dams were also tested in terrace outlet ditches (fig. 10). A rock masonry structure typical of those used for terrace outlet control in this study is shown in figure 11.

FIGURE 11. Rock masonry dam used for terrace outlet control.

Many types of promising vegetation were also tried with and without mechanical support. These included Bermuda grass set in strips and sodded solid; small grain, such as oats and sorghum; the annual lespedezas, a perennial lespedeza (*L. sericea*), kudzu, black locust, and Dallis grass (*P. dilatatum*). Bermuda grass was also used in sod-bag dams and in conjunction with temporary mechanical structures.

Cost records were maintained on the various types of structures, and their performance and usefull life observed.

Contributing Records

Climatic data.—A standard United States Weather Bureau station is located at the station headquarters where daily records are kept on maximum and minimum temperatures, wind movement, freewater surface evaporation, and rainfall (fig. 12). In addition a record of the daily rainfall is obtained from standard recording rain gages located in the immediate vicinity of the various experimental areas.

FIGURE 12.—Central meteorological station. Substation No. 2 of the Texas Agricultural Experiment Station.

EXPERIMENTAL RESULTS

Rainfall Characteristics and Erosion

Rainfall is the primary cause of erosion, and runoff water is the active agent which produces erosion. It is impossible to analyze the records of studies on factors contributing to the rate of erosion, or its control, until the characteristics of the rainfall causing erosion are evaluated. Rain falling on bare soil will cause runoff as soon as the soil's ability to receive and store moisture is exceeded or when the rain comes at a rate in excess of that at which water can infiltrate into the soil; hence, both the total amount of rain that falls and the intensity of the rain may have an important bearing on the resultant runoff. The point at which this excess is reached is also dependent upon the physical characteristics of the soil at the time of the rain. After the basic relationship between the fall of rain on a bare soil and runoff or soil loss is established, the influence of secondary factors, such as vegetal cover and supporting practices of a mechanical nature, can be evaluated.

A complete record of the rainfall has been maintained by the Texas Substation No. 2 since 1905, and rainfall by individual storm records of amount and rate of fall has been recorded on selfrecording gages since 1931.

A comparison of the annual rainfall for the 36 years of record and for the 10-year period 1931–40 is shown in figures 13 and 14. It is evident from these records that the latter period has been somewhat drier, averaging 2.32 inches less per year than the long-time average rainfall. Figure 14 shows the average annual rainfall by monthly increments for the 36-year period and the 10-year period of erosion-control study. These data show that the 2.32 inches smaller average annual total rainfall for the 10-year period has been compensated for to some degree by the more favorable distribution of the rainfall through the crop-growing season.

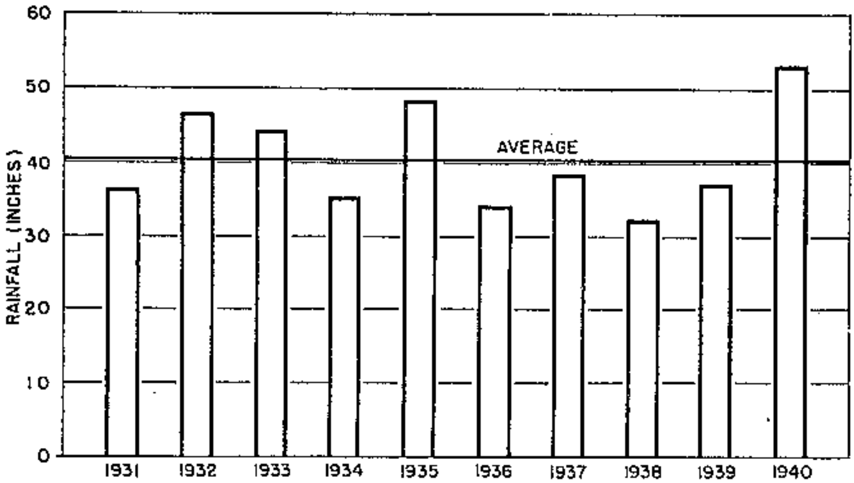

FIGURE 13.—Annual and average rainfall for the 10-year period 1931-40 from control-plot gage, Soil and Water Conservation Experiment Station, Tyler, Tex.

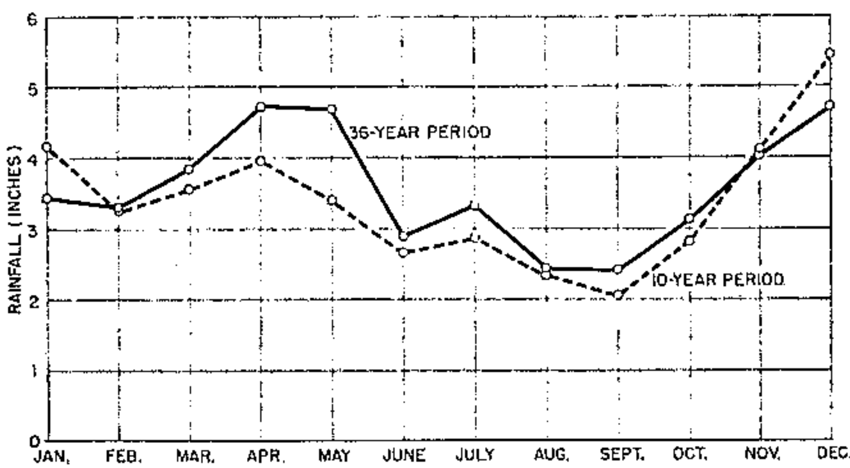

FIGURE 14.—Average rainfall distribution by months for the 10-year period 1931-40 and the 36-year period 1905-40.

A comparison of the average monthly amounts of rainfall during the 10-year period 1931–40 with the average monthly soil losses from control plot 3, continuous cotton on Kirvin fine sandy loam (fig. 15), shows that there is a tendency for soil losses to increase with increase in rainfall during the late fall and winter months. However, there is a distinct reversal of this trend during the months of April, May, June, and July. This would indicate that some characteristic of rainfall other than total amount is responsible for erosion rate during this period of the year.

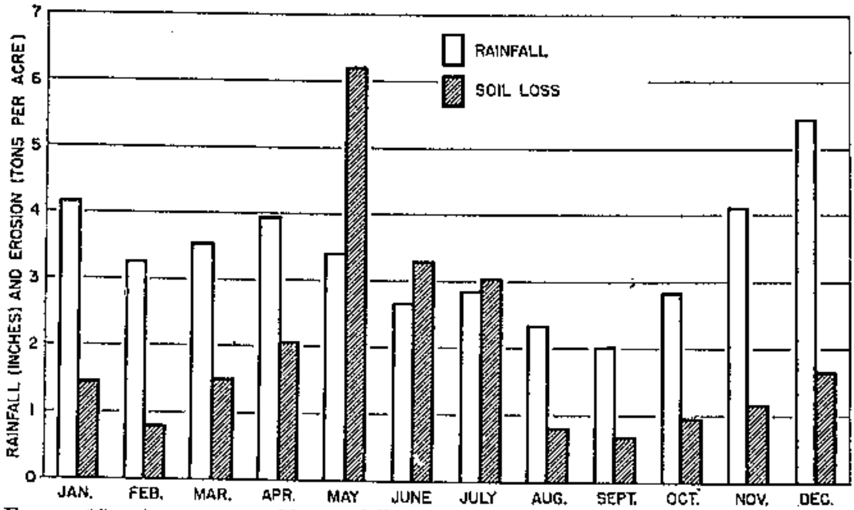

FIGURE 15.—Average monthly rainfall and soil loss from control plot 3 for the 10-year period 1931–40.

Figure 16 shows maximum rainfall intensities for 5-minute, 15-minute, and 30-minute periods and the average soil loss by months. There

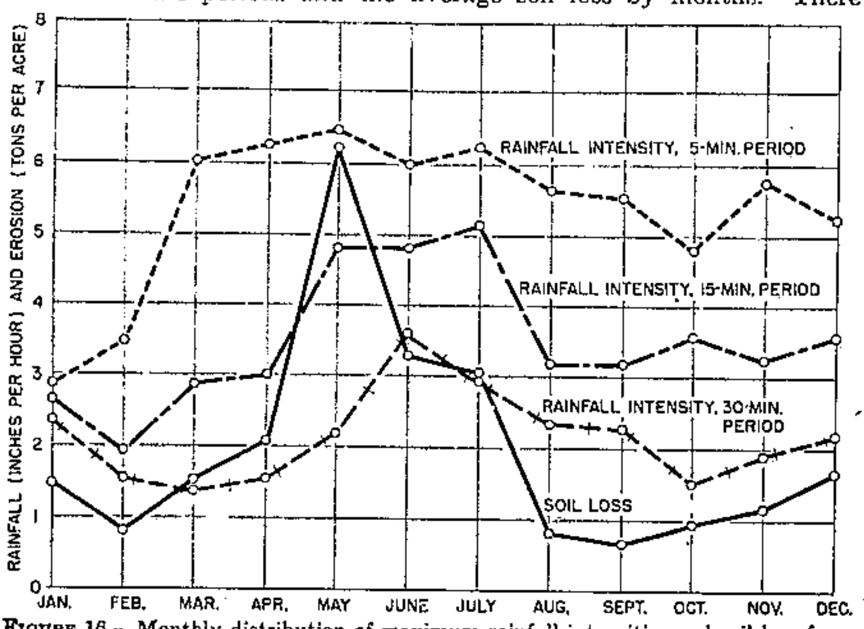

FIGURE 16.—Monthly distribution of maximum rainfall intensities and soil loss from control plot 3 for the 10-year period 1931–40.

appears to be a close similarity in trend between the fluctuations in intensity of the rainfall and the amounts of soil lost from control plot 3. The soil loss curve follows the trend of the 15-minute period curve of rainfall intensities very closely. This combination of time and rate appears to produce a sufficient volume of water to exceed the soil's capacity to retain it.

These data show that soil losses on relatively bare Kirvin fine sandy loam do not necessarily result from large amounts of rainfall alone. Rainfall intensity variations throughout the seasons can be considered as a more direct indicator of probable erosion than any other characteristic of rainfall.

Of the 216 storms causing soil loss from control plot 3 during the period 1931 to 1940, 22 storms caused soil losses greater than 5,000 pounds per acre (table 2). These 22 storms caused a loss of 293,803 pounds out of the total of 485,179 pounds for the 10-year period of record, or on a percentage basis, 10 percent of the storms causing soil loss accounted for 60.5 percent of the total soil loss. Fifteen of these major storms occurred during the 5-month period, March to July; 8 during May and June, and 4 during December and January.

TABLE 2.—*Storms that caused 2½-tons or more, of soil loss per acre from control plo 3 for the 10-Year period, 1931-40.*

Date	Storm characteristics				Runoff as percent of total rain	Soil loss per storm per acre	Total soil loss per year per acre
	Amount	Maximum rate per hour					
		5-minute period	15-minute period	30-minute period			
	Inches	*Inches*	*Inches*	*Inches*	*Percent*	*Pounds*	*Pounds*
1931:							
June 13	1.60	3.60	2.40	2.20	21.1	5,950	
June 16-17	2.40	6.00	4.40	3.20	36.4	10,400	34,700
1932:							
July 22	1.47	7.20	4.40	2.84	43.3	12,080	
Dec. 23	3.19	4.80	3.20	2.20	51.2	8,410	35,480
1933:							
Apr. 25-26	2.00	5.28	2.32	1.50	29.0	10,320	
May 24-25	2.30	4.32	3.64	1.35	33.0	9,080	45,330
1934:							
Apr. 24	1.50	6.24	3.00	1.32	53.3	11,400	
Nov. 19	1.02	2.64	2.32	1.00	45.5	6,850	
Dec. 2	1.81	2.64	1.88	1.58	53.2	6,840	37,120
1935:							
Jan. 19-20	2.58	2.52	1.36	1.32	34.8	10,470	
Feb. 8	2.04	2.88	1.02	1.56	22.7	5,090	
Mar. 4	1.40	2.16	1.60	1.36	25.2	7,200	
May 2-4	5.52	4.80	2.96	2.20	43.5	12,300	
May 15	1.18	4.80	2.88	1.62	24.1	6,740	
July 3	1.23	6.24	2.88	1.92	35.0	13,700	71,820
1936:							
May 8-9-10	5.06	6.49	4.80	3.32	42.9	71,391	
Oct. 6-7	2.58	6.24	2.80	1.34	52.3	10,301	110,970
1937[1]							12,520
1938:							
Jan. 23	3.03	3.60	3.12	2.50	60.4	12,312	
Mar. 28	.80	5.28	2.64	1.38	67.5	5,908	
June 1	1.73	0.00	4.48	3.04	33.0	7,070	46,160
1939:							
July 9	1.79	6.48	5.12	2.94	41.4	31,524	48,190
1940:							
June 28—July 2	5.38	5.28	5.04	3.02	25.1	17,667	39,100

[1]No single storm produced as much as 2½ tons of soil loss.

The average number of severe storms, 2.2 per year, occurred 4 years out of the 10, 6 storms occurred in 1935, and none occurred in 1937.

The entire annual total soil loss of 12,520 pounds for 1937 was equaled or exceeded by the individual storm losses from 5 storms and closely approached by 4 others. One storm, May 8-9, 1936, caused nearly 6 times as much soil loss as the 1937 total annual loss and exceeded any other annual loss during the 10-year period except that of the year in which it occurred.

These data indicate that the major soil losses result from relatively few rains which may occur during any month of the year, but are most probable during May and June and least probable during August and September. The storms are characterized by the occurrence of high-intensity intervals during some part of the storm period. The highest intensities were reached by the spring and summer rains when the soil was most vulnerable to erosion. This fact points to the possibility of greatly reducing soil erosion losses through the employment of a cropping system that will provide the greatest possible protection during this vulnerable period.

A detailed record of the runoff and soil loss from the 12 control plots on Kirvin fine sandy loam, for individual rains, is given in tables 30 and 31, Appendix.

Control-Plot Experiments

The control plots and plot treatments have been fully described under the heading Control-Plot Installations, p. ---.

TABLE 3.—*Ten-year average annual runoff, soil loss, and crop yield from control plots, 1931–40.*

[Kirvin fine sandy loam—8.75-percent slope. Average rainfall 40.66 inches.]

Plot No.	Crop and treatment [1]	Surface runoff		Soil loss per acre	Yield of seed cotton per acre
		Depth	Percent of total rainfall		
		Inches	*Percent*	*Tons*	*Pounds*
1	Continuous cotton	7.53	18.5	14.50	443
2	Continuous cotton	7.52	18.5	33.20	352
3	Continuous cotton	8.10	19.9	24.07	420
4	Continuous cotton	7.23	17.8	22.39	492
5	Rotation [2] cotton (average 4 yrs.)	6.85	16.8	17.20	469
6	Rotation [2] cotton (average 3 yrs.)	7.35	18.1	16.78	453
7	Rotation [2] cotton (average 3 yrs.)	6.89	17.0	17.02	403
8	Continuous Bermuda grass, clipped	.41	1.0	.08	(4)
9	Bare fallow [3]	7.36	18.1	20.99	(5)
10	Desurfaced, cotton	10.18	25.0	55.54	162
11	Desurfaced, cotton	10.16	25.0	62.84	158
12	Desurfaced, cotton	10.37	25.5	58.64	97

[1] Beginning in 1935 plots 1, 2, 3, 4, 11, and 12 received 400 lbs. per acre of 4–8–4. Plots 5, 6, 7, and 10 received 100 lbs. superphosphate per acre at the time of seeding vetch cover crop. All plots were cultivated flat except plots 4 and 12 which had ridge cultivation in 1935.
[2] A rotation of cotton, corn, and lespedeza was practiced until 1935, after which sorghum replaced corn and cowpeas replaced lespedeza. In 1936 vetch cover crop replaced small grain cover crop on plots 5, 6, and 7.
[3] Plot 9 was hard fallow until 1935, after which it was cultivated.
[4] No yield taken.
[5] No crop.

The control-plot records, tables 3, 4, 5, and 6, indicate that several factors, singly and in combination, are instrumental in determining the amount of runoff and soil loss. Increases in length or degree of slope caused increases in loss of soil but did not materially increase water losses. The physical properties of soil, such as are used to differentiate soil series and soil types, are important factors in determining soil and water losses. The Kirvin series on an 8.75-percent slope eroded at a more rapid rate than the Nacogdoches under similar treatment on a 10-percent slope. Topsoil did not erode as rapidly as subsoil exposed by desurfacing. Table 3 indicates that the large increase in losses from the desurfaced plots over those of normal profile was probably the result of a combination of two factors; namely, inherent difference in physical characteristics of topsoil and subsoil, with corresponding difference in ability to resist erosion, and the difference in the density of the vegetative cover furnished by cotton crops grown on the test plots.

TABLE 4.—*Eight-year average annual runoff, soil loss, and crop yield from control plots, 1933–40.*

[Kirvin fine sandy loam, 16.5-percent slope. Average rainfall, 41.48 inches.]

Plot No.	Crop and treatment [1]	Surface runoff		Soil loss per acre	Yield per acre seed cotton
		Depth	Percent of total rainfall		
		Inches	*Percent*	*Tons*	*Pounds*
Plot 1, 36 feet	Continuous cotton	4.87	11.7	39.55	575
Plot 2, 72 feet	Continuous cotton	5.97	14.4	61.06	452
Plot 3	Bermuda grass, clipped	.11	.3	.005	(2)

[1] Beginning with 1935 cotton received 400 pounds 4–8–4 fertilizer per acre at time of planting.
[2] No yield taken.

TABLE 5.—*Nine-year average annual runoff, soil loss, and crop yield from control plots, 1932–40.*

[Nacogdoches fine sandy loam, 10.0-percent slope. Average rainfall, 41.68 inches.]

Plot No.	Crop and treatment [1]	Surface runoff		Soil loss per acre	Yield of seed cotton per acre
		Depth	Total rainfall		
		Inches	*Percent*	*Tons*	*Pounds*
Plot 1, 30 feet	Continuous cotton	6.09	14.6	5.57	450
Plot 2, 72 feet	Continuous cotton	5.79	13.9	6.46	420
Plot 3	Bermuda grass, clipped, desurfaced	.14	.3	.005	(2)
Plot 4, 72 feet	Continuous cotton	1.97	4.7	24.49	120

[1] Beginning with 1935 cotton received 400 pounds 4–8–4 fertilizer per acre at time of planting.
[2] No yield taken.

TABLE 6.—*Nine-year average annual runoff and soil loss from hardwood control plots, 1932–40.*

[Kirvin fine sandy loam, 12.5-percent slope. Average annual rainfall 40.95 inches.]

Plot No.	Treatment	Surface runoff		Soil loss per acre
		Depth	Percent of total rainfall	
		Inches	*Percent*	*Tons*
1	Burned in March	1.07	2.6	.36
2	Not burned	.14	.3	.05

The evidence supplied by the control plots (See figs. 6 and 7, pp. 15, 16) indicates that the effects of the various physical factors influencing erosion can be masked or completely counterbalanced by the protective attributes of vegetative cover. The effect of vegetative cover in

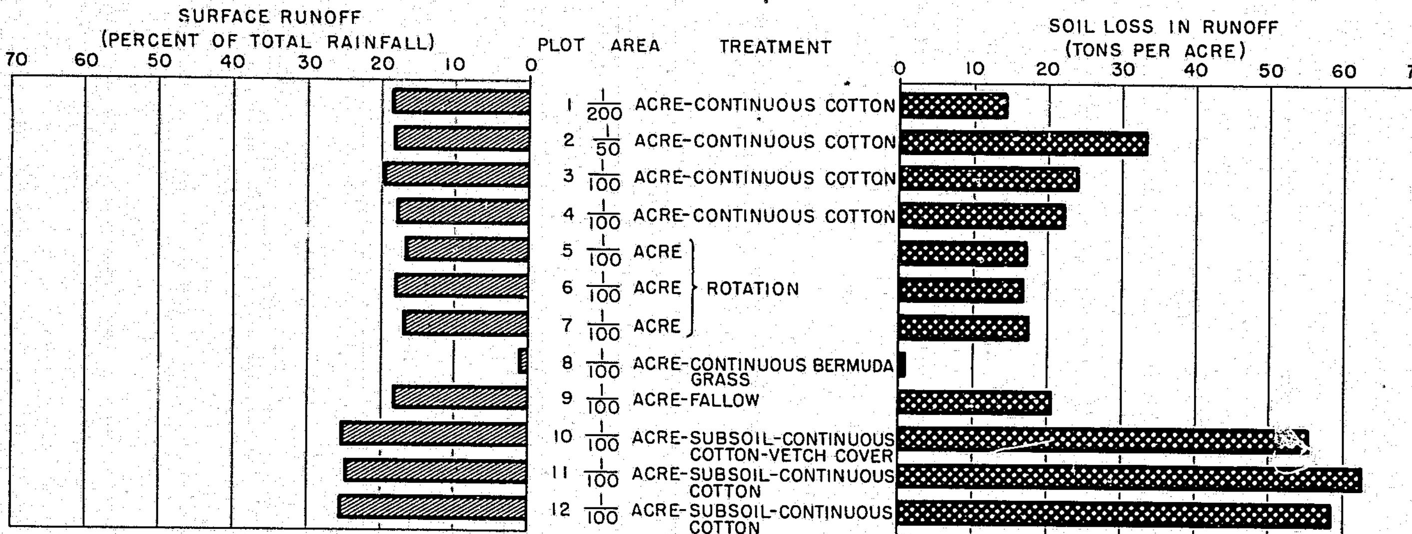

FIGURE 17.—Average annual soil and water losses from Kirvin Control plots, 8.75-percent slope for the period of record 1931–40.

control of soil losses is in direct proportion to the quantity and quality of the cover afforded and the time that it occupies the land.

Continuous cover of Bermuda grass or hardwood forest gave highly effective protection from both soil and water losses, irrespective of degree of slope or difference in soil type. Losses of soil and water were negligible in both cases. The treatments of control plots and average losses from various crops on 8.75-percent slope of Kirvin soil are presented in figure 17.

A detailed discussion of the factors influencing the rate of erosion is given in the following accounts of the several studies and the comparisons available from the control-plot data.

Soil series.—Two of the important soil series of the area—Kirvin and Nacogdoches—were put under measurement in order to determine the relative rates of erosion that occurred under similar cultural treatment. The results over the period of record, where the topsoil and subsoil of both series have been cropped continuously to cotton, showed a wide difference in surface runoff and soil loss. The average soil losses from Kirvin on an 8.75-percent slope, have been three times greater than from Nacogdoches on a 10.0-percent slope with the same crops, seasons, and cultural treatments. A comparison of these two soils, under both topsoil and subsoil conditions, where crops and treatments were duplicated, is presented in table 7.

TABLE 7.—*Surface runoff and soil loss from Kirvin and Nacogdoches soils under similar crop and cultural treatments, 1932–40.*

Plot No.	Soil series	Slope	Average annual rainfall	Surface runoff		Soil loss per acre
				Depth	Percent of total rainfall	
		Percent	*Inches*	*Inches*	*Percent*	*Tons*
2	Nacogdoches topsoil	10.0	41.68	6.1	14.61	5.57
3	Kirvin topsoil	8.75	41.17	8.5	20.55	24.82
4	Nacogdoches subsoil	10.0	41.68	8.6	20.71	24.45
11	Kirvin subsoil	8.75	41.17	10.6	25.77	63.30

Slope length.—This study was conducted on seven control plots, three of which were on Kirvin with 8.75-percent slope, two on Kirvin with 16.5-percent slope, and two on Nacogdoches with 10.0-percent slope. The average annual soil losses, as shown in figure 18, from the three plot lengths, 36.3, 72.6, and 145.2 feet, on the 8.75-percent slope Kirvin with the same crop and cultural treatment were 14.50, 24.07, and 33.20 tons per acre, respectively, for the 10-year period of record. The percentages of surface runoff for the same period from the three different slope lengths were 18.5, 19.9, and 18.5, respectively. The data secured on the 36.3-foot and the 72.6-foot length plots located on 16.5-percent slope Kirvin show a similar trend. These data indicate that a definite increase in soil loss may be expected with an increase in slope length on Kirvin. No material differences are shown in the percentages of surface runoff from the three different slope lengths.

The soil losses on the slope lengths of the three groups of plots were consistently higher on the longer slopes. However, the differences were not so great on Nacogdoches as on Kirvin. A summary of the comparative losses from the different slope lengths is given in table 8.

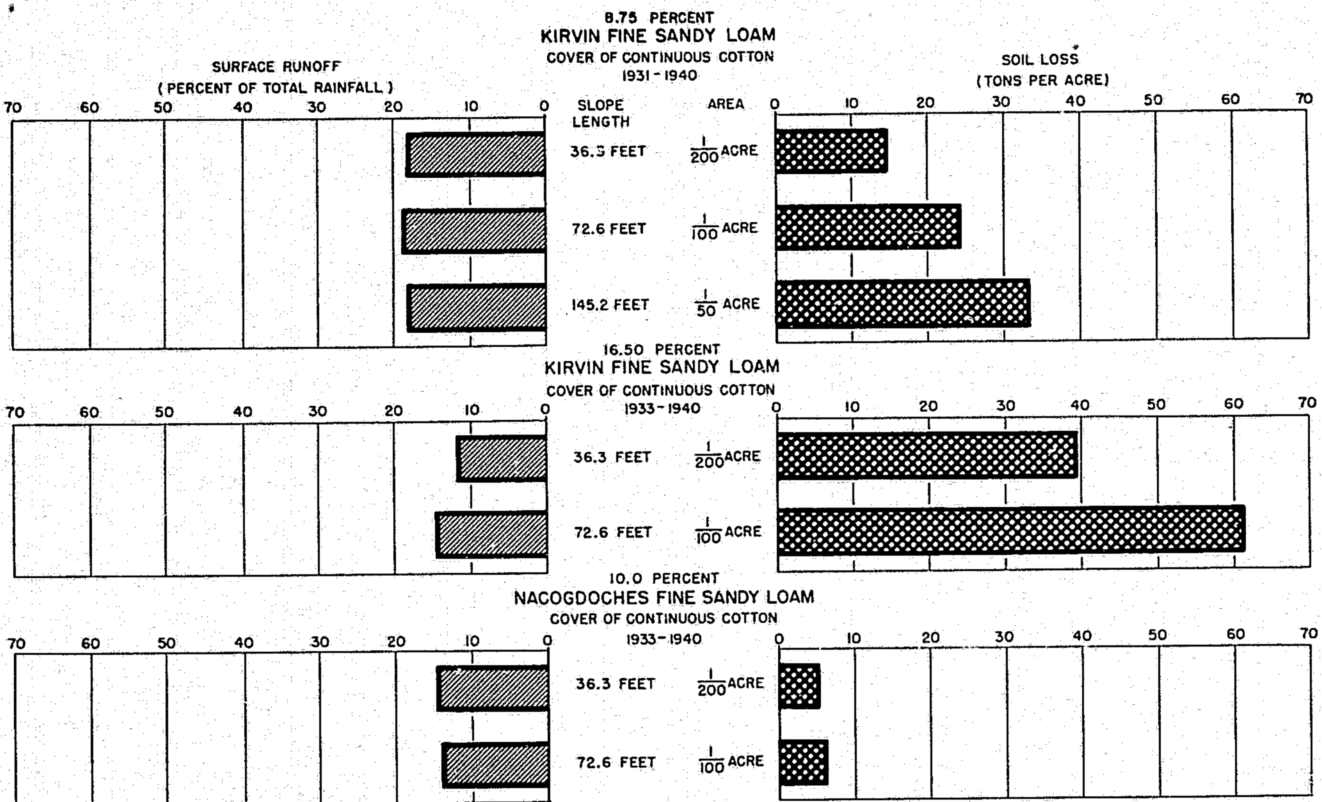

FIGURE 18.—Average surface runoff and soil loss from control plots on various slope lengths.

TABLE 8.—*Average soil and water losses from different slope lengths for the period of record, 1931–40.*

10-YEAR AVERAGE, 1931–40

Plot No.	Soil	Slope	Plot dimensions	Crop	Rainfall	Surface runoff	Soil loss per acre
		Percent	*Feet*		*Inches*	*Percent*	*Tons*
1	Kirvin	8.75	6 x 36.3	Cotton	40.66	18.52	14.50
3	Kirvin	8.75	6 x 72.6	Cotton	40.66	19.92	24.07
2	Kirvin	8.75	6 x 145.2	Cotton	40.66	18.49	33.20
			8-YEAR AVERAGE, 1933–40				
1	Kirvin	16.5	6 x 36.3	Cotton	41.48	11.74	39.55
2	Kirvin	16.5	6 x 72.6	Cotton	41.48	14.39	61.06
			9-YEAR AVERAGE, 1932–40				
1	Nacogdoches	10.0	6 x 36.3	Cotton	41.68	14.01	5.57
2	Nacogdoches	10.0	6 x 72.6	Cotton	41.68	13.89	6.46

Degree of slope.—The degree of slope may be the determining factor in the selection of a kind of crop which may be successfully grown on an area without excessive soil losses. The utilization of steep slopes, however, should be confined to perennial crops having a high degree of erosion-resistant ability. The continuous cotton plots on 16.5-percent slope Kirvin lost over 2½ times more soil per acre than similar plots on 8.75-percent slope Kirvin. Bermuda grass sod on the two degrees of slope did not show any material differences in the surface runoff and soil losses, as both were of negligible quantity (table 9).

TABLE 9.—*Average soil and water losses from control plots of different degrees of slopes.* [1]

10-YEAR AVERAGE, 1931–40

Plot No.	Soil	Slope	Dimensions	Crop	Rainfall	Surface runoff	Soil loss per acre
		Percent			*Inches*	*Percent*	*Tons*
1	Kirvin	8.75	6 x 36.3	Cotton	40.66	18.52	14.50
3	Kirvin	8.75	6 x 72.6	Cotton	40.66	18.49	24.07
8	Kirvin	8.75	6 x 72.6	Bermuda grass	40.66	1.01	.08
			8-YEAR AVERAGE, 1933–40				
1	Kirvin	16.5	6 x 36.3	Cotton	41.48	11.74	39.53
2	Kirvin	16.5	6 x 72.6	Cotton	41.48	14.39	61.06
3	Kirvin	16.5	6 x 72.6	Bermuda grass	41.48	.27	.01

[1] For a detailed record of runoff, soil losses, and yields see tables 32, 33, and 34, Appendix.

Plant cover.—The effectiveness of the protection afforded by plant cover against surface runoff and soil loss has been clearly demonstrated by the grass and forest cover plots (table 10). No attempt has been made to separate or evaluate the importance of the different contributing factors—including canopy interception, surface protection, soil structural changes, and biological activity. The important fact clearly demonstrated is that both grass and forest cover have played an outstanding part in decreasing surface runoff and soil losses to negligible quantities as compared to the losses resulting from intensively cultivated crops.

Burning of the surface litter has increased both surface runoff and soil losses from the wooded area. Average runoff and soil loss by seasons is recorded in table 35, Appendix. The surface runoff and soil losses from the Bermuda grass plots were relatively constant after the sod became well-established. The control-plot studies show that a good vegetative cover is not seriously affected by wide variation in soil type, slope factors, or rainfall characteristics, and that the degree of effectiveness to which it may be used as an erosion-control measure is dependent upon the quality of the cover and time that it occupies the ground.

TABLE 10.—*Average losses from control plots with different plant covers.*

Period of Record	Soil	Slope	Dimensions	Crop	Average annual rainfall	Surface runoff	Soil loss per acre	Time to erode 1 inch of soil [1]
		Percent	*Feet*		*Inches*	*Percent*	*Tons*	*Years*
1931–40	Kirvin	8.75	6 x 72.6	Cotton	40.66	19.92	24.07	8
1931–40	Kirvin	8.75	6 x 72.6	Bermuda grass	40.66	1.01	.08	2,550
1931–40	Kirvin	8.75	6 x 72.6	Fallow [2]	40.66	18.10	20.99	10
1933–40	Kirvin	16.5	6 x 72.6	Cotton	41.48	14.39	61.06	3
1933–40	Kirvin	16.5	6 x 72.6	Bermuda grass	41.48	.27	.01	20,400
1932–40	Kirvin	12.5	6 x 72.6	Woods (not burned)	40.05	.34	.05	4,080
1932–40	Kirvin	12.5	6 x 72.6	Woods (burned)	40.05	2.61	.36	567
1932–40	Nacogdoches	10.0	6 x 72.6	Cotton	41.08	13.59	6.46	27
1932–40	Nacogdoches	10.0	6 x 72.6	Bermuda grass.	41.68	.34	.01	17,500

[1] Average weight of an acre-inch of Kirvin topsoil is approximately 204 tons. The average weight of an acre-inch of Nacogdoches topsoil is approximately 175 tons.
[2] Hard fallow, 1931–34; cultivated fallow, 1935–40.

Seasonal runoff and soil losses for the several groups of control plots are given in tables 36 and 37, Appendix.

Crop rotation.—Plots 3, 5, 6, and 7 were used in the crop-rotation study. Plots 5, 6, and 7 were planted in a 3-year rotation of cotton, corn, and lespedeza with a small-grain winter cover crop, which was turned under as green-manure preceding the planting of each of the three harvested crops. Plot 3 was planted continuously to cotton without a winter cover crop. This cropping system was continued from 1931 through 1935. At this time the system was changed to sorghum, cowpeas, and cotton with vetch as the winter cover crop.

The data over the period of record show a consistent decrease in soil loss as a result of the combined effects of the rotation of crops and winter cover crops. However, there has usually been a period during the late fall or early winter when the soil loss was higher in the rotation plot than in the continuous cotton plot. Over the period of record, however, the continuous cotton plot without a cover crop lost an average of 24.07 tons of soil per acre; whereas, the plot on which the 3-year rotation and winter cover crop plan was followed lost only 17.20 tons per acre, a difference of 6.87 tons or 28.5 percent in soil loss. During the last 5 years, the average soil loss from the original continuous cotton plot 3 was 25.7 tons per acre and from the rotation plots 5, 6, and 7, the soil loss was 16.19 tons, a difference of 9.51 tons or 37 percent in favor of the rotation treatment (fig. 19).

This study has clearly demonstrated the efficiency of a cropping system which includes legumes and winter cover crops as a soil conservation practice. The yield of cotton in the rotation has been equally as good

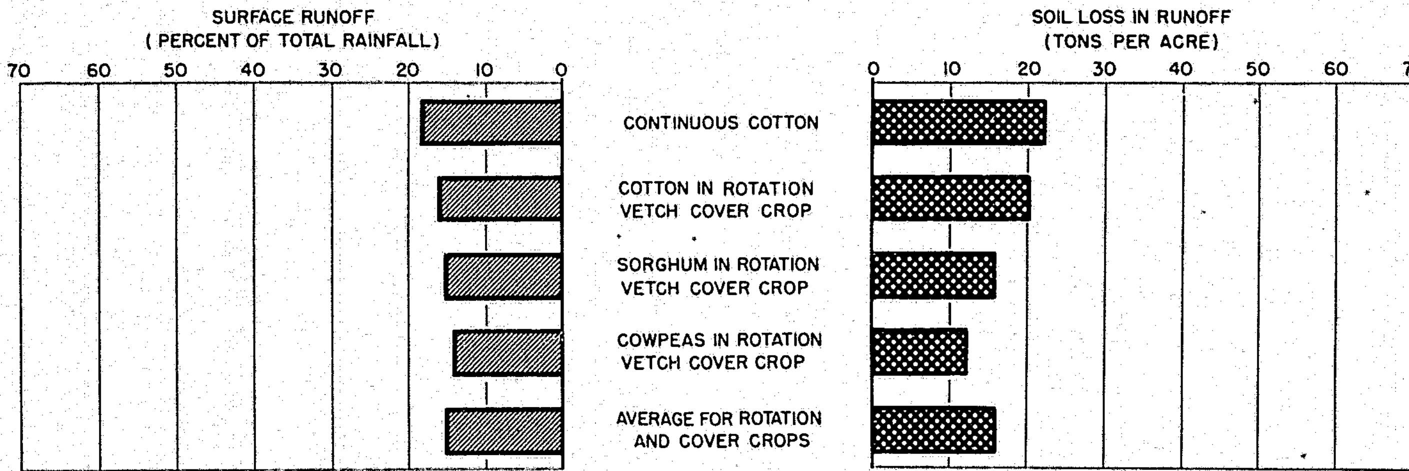

FIGURE 19.—Effect of crop rotation with vetch cover crop on soil and water losses from 8.75-percent Kirvin control plots for period 1936–40.

as that when cotton is grown continuously and an application of 400 pounds of 4–8–4 commercial fertilizer per acre applied annually. The only fertilizer used on the rotation was 100 pounds of superphosphate per acre annually, applied to the vetch winter-cover crop.

Organic matter treatments.—The beneficial effects on crop yields of the application of organic matter to the soil has long been recognized throughout the region. However, the effects of such treatment on the amount of surface runoff and soil loss has not been determined. Plots treated with various types of organic matter were installed in 1933 and measurements were made through 1935. Table 11 shows the results obtained for the period of record.

TABLE 11.—Organic-matter treatment, 1933–35.

[Kirvin soil, 0.50 percent slope, plots 72.6 x 12 feet, 1/50 acre]

Plot No. and year	Crop and treatment	Rainfall	Surface runoff		Soil loss per acre	Yield per acre [2]
		Inches	*Inches*	*Percent*	*Tons*	*Pounds*
1:						
1933 [1]	Check-cotton	23.63	2.25	9.5	0.65	1,120
1934	Check-cotton	35.18	4.18	11.9	4.40	225
1935	Check-cotton, 400 lbs. per acre of 4–8–4.	48.48	9.61	19.8	6.73	495
Total		107.29	16.04		11.78	1,840
2½-year average		42.92	6.42	15.0	4.71	613
2:						
1933 [1]	Cotton—15 tons per acre of oak leaves.	23.63	.57	2.4	.45	1,410
1934	Cotton	35.18	4.20	11.9	3.96	255
1935	Cotton—400 lbs. 4–8–4 per acre.	48.48	8.92	18.4	5.81	525
Total		107.29	13.69		9.72	2,190
2½-year average		42.92	5.48	12.8	3.89	730
3:						
1933 [1]	Cotton—10 tons compost per acre.	23.63	2.03	8.6	.48	1,295
1934	Cotton	35.18	4.72	13.4	2.78	235
1935	Cotton—400 lbs. 4–8–4 per acre.	48.48	11.00	20.7	5.65	490
Total		107.29	17.75		8.91	2,110
2½-year average		42.92	7.10	16.5	3.56	703
4:						
1933 [1]	Cotton—10 tons per acre barnyard manure.	23.63	2.03	8.6	.56	1,385
1934	Cotton	35.18	5.28	15.0	4.07	225
1935	Cotton—400 lbs. 4–8–4 per acre.	48.48	11.72	24.2	7.07	530
Total		107.29	19.03		11.70	2,140
2½-year average		42.92	7.61	17.7	4.68	713

[1] Measurements started July 1, 1933.
[2] Seed cotton.

These data do not show a clear trend as to results by treatments, but indicate that the most benefit occurred during the first season after their application. The measuring equipment was not installed in time to measure the losses during the vulnerable period for this year, but from careful observations made prior to actual recorded measurements the organic-matter applications, especially oak leaves, were found to be very effective in reducing both runoff and soil losses during this period. The record of the following years of study as well as the average soil and water losses for the entire period of record indicate that benefits accruing from additions of organic matter are confined, to a large degree, to the first year after application. Little residual effect is discernible after decomposition of the organic matter has occurred.

Strip cropping.—Contour strip cropping as an erosion-control measure in this area is a comparatively new practice and many details of its adaptation remain to be worked out. Contour strip cropping—the planting of crops of erosion-resistant qualities in strips—is carried on for the purpose of decreasing the rate of flow of surface runoff and thus causing the material carried in suspension to be deposited in the strip. The strips serve as a runoff spreader also, thus decreasing the concentration of runoff as it passes down the slope, and reducing its cutting effect. This study indicates that strip cropping as practiced at this station reduced soil loss on ungullied slopes.

On a 5.5-percent slope of Bowie fine sandy loam, with a slope length of 145.2 feet in which 50 percent of the strip-cropped plot was a resistant crop, the soil loss was only 5.9 tons per acre; whereas, on the check plot the soil loss was 17.6 tons per acre. These results were recorded in a study covering a period of 4 years, 1935–38. There was no corresponding difference in the average surface runoff, however. The strip-cropped plot lost 4.51 inches and the check plot lost 4.41 inches as surface runoff. The average data for the period of record are given in table 12.

TABLE 12.—*Runoff and soil losses for strip-cropped control plots of Bowie fine sandy loam.* [1]

[4-YEAR AVERAGE, 1935-38]

Plots	Rainfall	Runoff		Soil loss per acre	Crop and treatment [2]
	Inches	*Inches*	*Percent*	*Tons*	
Strip-cropped	38.40	4.52	11.8	5.89	Control strip: Sorghum interplanted with cowpeas and followed by oats in the spring. Erodible strip: Cotton, followed by vetch cover crop plowed under preceding the planting of cotton.
Check	38.40	4.41	11.5	17.56	Continuous cotton, followed by vetch cover crop which was plowed under preceding the planting of cotton in the spring.

[1] Slope length 145 feet.
[2] Commercial fertilizer at the rate of 200 lbs. per acre of 6-9-3 was applied at the time of seeding of the spring-planted oat strips. All vetch cover crops on the erodible strips and check plot received superphosphate at the rate of 100 pounds per acre at the time of seeding of the vetch.

On a 6.5-percent slope of Kirvin soil with a length of 72.6 feet and in which 50 percent of the plots were planted to a resistant crop, the average soil loss from the strip-cropped plots was 24 tons per acre, as compared to 27 tons per acre on the check plots. Again, there were no material differences in the average surface runoff from the two treatments. The strip-cropped plots lost an average of 4.7 inches of surface runoff and the check plots 4.4 inches. The results for the period of record are given in table 13.

Cultural methods of resisting erosion with crops.—Three plots (one-fiftieth acre, 72.6 feet in length and 12 feet wide) located on an 8-percent slope of Kirvin fine sandy loam were used in this study. The plots were enclosed by 12-inch boards, 6 inches of which were submerged below the surface of the ground to prevent outside water from entering the plot areas. Two of the plots, 7 and 8, were equipped with Geib divisors. The other, plot 5, had a Uhland-type divisor which after the first year was replaced by a Geib divisor.

TABLE 13.—*Runoff and soil losses for strip-cropped control plots of Kirvin fine sandy loam.* [1]

[3-YEAR AVERAGE, 1936-38]

Plot	Rainfall	Runoff		Soil loss per acre	Crop and treatment
		Inches	*Percent*	*Tons*	
Strip-cropped	35.04	4.67	13.3	24.04	Control strip: Sorghum, interplanted with cowpeas followed by oats planted in the spring. Erodible strip: Cotton, followed by vetch cover crop turned under preceding the planting of cotton in the spring.
Check	35.04	4.41	12.6	26.92	Continuous cotton, vetch cover crop turned under preceding the planting of cotton in the spring.

[1] Slope length 72 feet; 6.5-percent slope.

The treatments consisted of a mixture of sorghum and cowpeas which were planted flat and on the contour in 7-inch, 24-inch, and 42-inch drill spacings. The rate of seeding on the 7-inch spacing was 30 pounds of sorghum and 10 pounds of cowpeas per acre; on the 24-inch spacing, 10 pounds of sorghum and 10 pounds of cowpeas per acre; and on the 42-inch spacing, 5 pounds of sorghum and 10 pounds of cowpeas per acre. The plots planted in 24- and 42-inch spacings were cultivated twice during the growing season; whereas, the 7-inch spacing was cultivated only once. A uniform application of 4–8–4 fertilizer was applied at the rate of 200 pounds per acre at the time of planting. The crops were harvested on the same date when a satisfactory stage of maturity for feed was reached. Yields were recorded in air-dry weights per plot. The records of surface runoff, soil loss, and crop yield from these plots for the period of record, 1936-38, show only negligible differences between the results from the several treatments. With the 7-inch spacing there was an average loss of 6 inches in surface runoff and 6.8 tons of soil per acre; with the 24-inch spacing, 5.7 inches in surface runoff and 8 tons of soil per acre; and with the 42-inch spacing, 5.6 inches in surface runoff and 6 tons of soil per acre. There was, as is shown, only a slight difference in soil losses from the two extremes of 7- and 42-inch spacings. The yield of air-dry feed per acre from the 7-inch, 24-inch, and 42-inch spacings was 4.6, 5.0, and 4.6 tons, respectively. A finer quality of feed was produced on the thicker spacing as compared with the forage produced on the wider spacings. Since there was no outstanding difference in either soil or water losses, the ultimate use for which the crop is grown appears to be the determining factor in the selection of row spacings for sorghum and cowpea mixtures in this region.

Field Areas

Strip cropping with terraces.—As an additional means of reducing soil loss from crops on terraced land, strips of erosion-resistant crops alternating with the more susceptible crops may be used in the cropping system. The location of these control strips is important since it may determine the amount of silt carried into the terrace channel.

This study shows that when the control strip is located immediately above and includes the terrace channel, the losses are less than when it is on the midinterval or directly below and adjacent to the terrace ridge. The average losses from sorghum and oat control strips on different locations within the terrace intervals are given for comparison with the check intervals in table 14.

TABLE 14.—*Average annual surface runoff and soil loss from strip-cropped terraces, 1937–40, 5.5- to 6.5-percent slope.*

[Terraces 700 feet long, 3-inch grade, 3-foot vertical interval. Average annual rainfall 39.63 inches.]

Location of strip and crops used	Crop and treatment	Surface runoff		Soil loss per acre
		Depth	Rainfall	
		Inches	*Percent*	*Tons*
Check, no control strip	Rotation: Cotton and corn with vetch cover crop following corn and oat cover crop following cotton.	7.94	20.0	4.72
Midinterval (sorghum and oats)	Rotation: Corn and cotton on erodible area with vetch cover crop following corn and oats following cotton.	8.78	22.2	4.77
Above and including channel (sorghum and oats).	Rotation: Corn and cotton on erodible area with vetch cover crop following corn and oats following cotton.	7.13	18.0	2.71
Below and adjacent to terrace ridge (sorghum and oats).	Rotation: Corn and cotton on erodible area with vetch cover crop following corn and oats following cotton.	8.69	21.9	3.75

Short terraces with uniform and variable grades.—This experiment was conducted with five terraces numbered C-4, C-5, C-6, C-7, and C-10, in order to determine a satisfactory grade for short terraces. Physical characteristics and average soil and water losses are given in table 15.

TABLE 15.—*Soil and water losses from the ends of 700-foot terraces with uniform and variable grades.*

Terrace No.	Interterrace area	Average land slope	Average vertical interval	Grade per 100 feet	Runoff		Soil [1] loss per acre
					Depth	Ratio of runoff to rainfall	
	Acres	*Percent*	*Feet*	*Inches*	*Inches*	*Percent*	*Tons*
C-4	1.08	6.4	4.7	6	14.32	35.7	12.37
C-5	1.05	6.3	3.8	0-6	13.92	34.7	10.90
C-6	1.04	5.9	3.9	0-3	8.47	21.1	5.55
C-7	1.02	5.8	3.9	(2)	7.21	18.0	4.39
C-10	1.09	6.4	4.0	3	10.55	26.3	5.01

[1] 8-yr. period 1931–38. Records for 1936 omitted because records for most of these terraces for the maximum rain of May 8–10, 1936, were lost owing to breaks in terraces on adjacent area.
[2] Level.

It should be noted that slight differences occurred in the average vertical interval of the terraces owing to the grades of adjacent terraces. It is believed, however, that this small difference in vertical interval had little or no effect on the results obtained.

Measurements from two of the terraces in this experiment, C-4 and C-5, were discontinued January 1, 1939; therefore, only the results for the 8-year period 1931–38 are presented for comparative purposes. A more detailed presentation of the data from these terraces may be found in table 16.

Results show a definite decrease in both soil and water losses with a decrease in terrace grade. Average loss with the terrace having a constant grade of 6 inches per 100 feet was 12.4 tons of soil per acre and 35.7 percent of the total rainfall; and with the 3-inch graded terrace 5.0 tons

TABLE 16.—*Annual records of runoff and soil loss from the ends of short terraces with uniform and variable grades, 1931–38*

Year	Total[1] precipitation	Runoff										Soil loss per acre				
		Depth					Runoff[2]									
		Terrace number					Terrace number					Terrace number				
		C–4	C–5	C–6	C–7	C–10	C–4	C–5	C–6	C–7	C–10	C–4	C–5	C–6	C–7	C–10
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
1931	34.72	6.83	5.15	2.12	1.32	4.07	19.7	14.8	6.1	3.8	11.7	9.83	5.77	3.25	5.05	4.22
1932	46.22	18.23	17.62	11.22	9.87	13.75	39.4	38.1	24.3	21.4	29.8	6.12	7.80	3.63	4.33	2.86
1933	45.66	16.18	16.41	8.16	6.41	12.15	35.4	35.9	17.9	14.0	26.6	16.35	16.72	7.81	4.55	6.72
1934	35.04	15.29	14.51	7.78	8.28	10.99	43.6	41.4	22.2	23.6	31.4	17.79	14.28	8.54	5.51	8.02
1935	48.57	21.99	24.26	14.89	15.17	16.73	45.3	50.0	30.6	31.2	34.4	21.28	20.67	8.90	7.31	7.67
1936[3]																
1937	38.64	12.35	10.19	7.75	4.01	8.86	32.0	26.4	20.1	10.4	22.9	7.32	5.30	3.14	1.55	2.49
1938	32.08	9.34	9.29	7.40	5.40	7.32	29.1	29.0	23.1	16.8	22.8	7.91	5.73	3.58	2.45	3.11
Total	280.93	100.21	97.43	59.32	50.45	73.87						86.60	76.27	38.85	30.75	35.09
Average annual	40.13	14.32	13.92	8.47	7.21	10.55	35.7	34.7	21.1	18.0	26.3	12.37	10.90	5.55	4.39	5.01

[1] Total annual precipitation as measured by recording rain gage, field C.
[2] In percent of total precipitation for the year.
[3] Records for 1936 are omitted from summary because records for most of these terraces for the maximum rain of May 8–10, 1936 were lost owing to breaks in terraces on an adjacent area.

of soil per acre and 26.3 percent of the rainfall. There was a similar decrease with the variable graded terraces, although the difference in soil loss was not quite so great. The 0–6- inch graded terrace lost approximately twice as much soil and 39 percent more runoff than the 0–3-inch graded terrace.

The level terrace was more efficient in retaining runoff but there was little difference in soil loss from the constant 3-inch, variable 0–3-inch, and the level terrace.

Long terraces with uniform and variable grades.—This experiment consisted of two terraces, 1,700 feet in length numbered C-12 and C-13, and was initiated to determine the effect of grade upon soil and water losses from long terraces. Differences in physical characteristics and the average annual soil and water losses resulting from these differences are shown in tables 17 and 18.

TABLE 17.—*Runoff and soil losses from long terraces with uniform and variable grades.*

Terrace No.	Interterrace area	Average land slope	Average vertical interval	Grade per 100 feet	Runoff		Soil [1] loss per acre
	Acres	*Percent*	*Feet*	*Inches*	*Inches*	*Percent*	*Tons*
C-12	2.46	7.4	4.7	0-3	9.51	22.7	5.38
C-13	2.65	6.8	5.0	3	9.08	21.7	6.37

[1] 10-yr. average 1931–41. Data for 1936 omitted because records for maximum rain of May 8–10, 1936 were lost owing to terrace breaks.

TABLE 18.—*Annual runoff and soil loss from the ends of long terraces with uniform and variable grades, 1931–41.*

Year	Total precipitation [1]	Runoff				Soil loss per acre	
		Terrace C-12	Terrace C-13	Terrace C-12	Terrace C-13	Terrace C-12	Terrace C-13
	Inches	*Inches*	*Inches*	*Percent*	*Percent*	*Tons*	*Tons*
1931	34.72	2.31	4.02	6.6	11.6	3.84	5.29
1932	46.22	11.27	12.87	24.4	27.8	4.50	5.03
1933	45.66	7.70	8.81	16.9	19.3	6.67	6.89
1934	36.04	9.81	11.01	28.0	31.4	8.90	10.57
1935	48.57	13.70	13.60	28.3	28.0	9.25	9.18
1936 [2]							
1937	38.04	7.34	7.72	19.0	20.0	3.43	4.29
1938	32.08	7.02	6.82	21.9	21.4	4.25	5.37
1939	35.60	6.69	6.08	18.7	17.0	2.31	2.85
1940	52.49	16.20	10.61	31.0	20.2	7.48	9.62
1941	49.60	12.90	9.20	26.0	18.7	3.10	4.67
Total	418.77	95.09	90.83			53.52	63.69
Average annual	41.88	9.51	9.08	22.7	21.7	5.38	6.37

[1] Total annual precipitation as measured by recording rain gage, field C.
[2] Records for 1936 omitted from summary because records for these terraces for maximum rain of May 8–10, 1936 were lost owing to breaks in terraces.

Experiments show that as in the case of the 1,700-foot terraces, there is slightly less runoff for the uniform grade while the soil loss is somewhat less for the variable than for the uniform grade terrace.

The additional length had little effect on the total amount of soil and water loss per acre. However, the peak rate of runoff was not so high but more prolonged than the characteristic flow from shorter terraces of similar design.

Terrace C-14, an adjacent terrace of similar characteristics but with an average vertical interval of 4 feet, lost slightly less runoff and approximately the same amount of soil as terrace C-13, over the period of record.

Short graded terraces with different vertical intervals.—Terraces C-8, C-9, C-10, and C-11 were used in this experiment. They had a uniform grade of 3 inches per 100 feet and were 700 feet long with an average land slope between 6 and 7 percent. Other physical characteristics and average soil and water losses are shown in tables 19 and 20.

TABLE 19.—*Runoff and soil loss from short graded terraces with different vertical intervals*

Terrace No.	Interterrace area	Average land slope	Average vertical interval	Runoff		Soil loss per acre [1]
	Acres	*Percent*	*Feet*	*Inches*	*Percent*	*Tons*
C-8	1.52	6.0	6.0	9.55	23.2	6.26
C-9	1.12	6.4	5.0	10.27	24.9	8.11
C-10	.91	6.4	4.0	10.93	26.5	5.30
C-11	.69	6.7	3.0	7.95	19.3	5.24

[1] 8-yr. period 1933–40. Data for 1936 omitted because records for maximum rain of May 8–10, 1936, were lost owing to breaks in terrace from an adjacent area.

Results from these terraces are consistent from year to year. There was very little difference in soil losses from the terraces with 3- and 4-foot vertical intervals, but there was a marked increase in runoff from terraces with intervals greater than the 4-foot interval.

Losses from terrace C-9, with a 5-foot vertical interval, were higher than the losses from C-8 with a 6-foot vertical interval. This was due partly to a gully that formed in the terrace interval of C-9 near the flume, which deposited a heavy load of soil in the silt box.

Although it was not reflected in the total soil loss measured from C-8, considerable gullying occurred on the long slope above this terrace. This was also true of terrace C-9, but to a lesser degree. The most satisfactory results from this series of terraces were recorded for terraces C-10 and C-11, with vertical intervals of 4 and 3 feet, respectively.

Long graded terraces with different vertical intervals.—Three terraces 1,700 feet long were used in this experiment. They were numbered C-13, C-14, and C-15 and had a uniform grade of 3 inches per 100 feet. The interterrace area, average land slope, and vertical interval, together with average soil and water losses are shown in tables 21 and 22.

This experiment showed that there is a small decrease in runoff as the vertical interval decreases. There was no significant difference in soil loss between terraces with 4- and 5-foot intervals. There was however, for the terrace with a 3-foot interval, a marked reduction. It should be noted that terrace C-14 had a greater land slope than the other two terraces in the experiment. There was also a greater amount of thin topsoil in the area it protected. These two factors probably contributed to the increased soil losses recorded for this terrace. Considerable gullying occurred between the terraces having the wider spacing.

Length of terraces.—Measurement of soil and water losses was confined to the three terraces C–10, C–14, and C–17, in this experiment although many other terraces were under observation for the period of record. These terraces had a uniform grade of 3 inches per 100 feet and a vertical interval of 4 feet. Other characteristics, together with soil and water losses for these terraces, are shown in tables 23 and 24.

TABLE 20.—*Annual runoff and soil loss from the ends of short graded terraces with different vertical intervals, 1933–40*

Year	Total[1] precipitation	Runoff								Soil loss per acre			
		Terrace								Terrace			
		C–8	C–9	C–10	C–11	C–8	C–9	C–10	C–11	C–8	C–9	C–10	C–11
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Tons*	*Tons*	*Tons*	*Tons*
1933	45.66	9.47	9.73	12.15	5.96	20.7	21.3	26.6	13.0	7.68	9.62	6.62	5.32
1934	35.04	9.52	8.78	10.99	5.09	27.2	25.0	31.4	14.5	8.97	11.50	8.02	6.15
1935	48.57	15.47	15.46	16.74	11.28	31.9	31.8	34.5	23.2	11.91	12.70	7.67	7.89
1936[2]													
1937	38.64	6.03	7.69	8.86	6.04	15.6	19.9	22.9	15.6	2.22	4.26	2.49	2.73
1938	32.08	6.17	7.09	7.32	7.05	19.2	22.1	22.8	22.0	3.13	4.65	3.11	4.00
1939	35.69	5.28	5.47	6.37	5.66	14.8	15.3	17.8	15.9	1.91	2.45	1.92	1.85
1940	52.49	14.91	17.68	14.06	14.58	28.4	33.7	26.8	27.8	8.03	11.61	7.28	8.76
Total	288.17	66.85	71.90	76.49	55.66					43.85	56.79	37.11	36.70
Average annual	41.17	9.55	10.27	10.93	7.95	23.2	24.9	26.5	19.3	6.26	8.11	5.30	5.24

[1] Total annual precipitation as measured by recording rain gage, field C.

[2] Records for 1936 omitted from summary because records for these terraces for the maximum rain of May 8–10, 1936 were lost owing to breaks in terraces on adjacent area.

TABLE 21.—*Runoff and soil loss from long terraces with different vertical intervals*

Terrace No.	Interterrace area	Average land slope	Average vertical interval	Runoff		Soil loss per acre [1]
	Acres	*Percent*	*Feet*	*Inches*	*Percent*	*Tons*
C-13	2.85	6.8	5.0	9.09	21.7	6.37
C-14	2.19	7.6	4.0	8.66	21.7	6.55
C-15	2.16	9.2	3.0	7.34	17.5	4.32

[1] 10-yr. average, 1931-41. Data for 1936 omitted because records for maximum rain of May 8-10, 1936 were lost owing to terrace breaks.

TABLE 22.—*Annual runoff and soil loss from the ends of long graded terraces with different vertical intervals, 1931–41*

Year	Total [1] precipitation	Runoff						Soil loss per acre		
		Terrace						Terrace		
		C-13	C-14	C-15	C-13	C-14	C-15	C-13	C-14	C-15
	Inches	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Tons*	*Tons*	*Tons*
1931	34.72	4.02	3.12	2.75	11.6	9.0	7.9	5.29	4.71	2.76
1932	46.22	12.87	11.30	8.26	27.8	24.4	17.9	5.03	4.94	3.03
1933	45.66	8.81	7.38	6.81	19.3	16.2	14.9	6.89	6.75	4.69
1934	35.04	11.01	9.94	7.57	31.4	28.4	21.6	10.57	9.42	5.78
1935	48.57	13.60	14.80	9.72	28.0	30.5	20.0	9.18	11.94	7.11
1936 [2]	------	------	------	------	------	------	------	------	------	------
1937	38.64	7.72	6.85	9.53	20.0	17.7	24.7	4.29	3.40	2.02
1938	32.08	6.88	5.91	5.26	21.4	18.4	16.4	5.37	4.56	3.26
1939	35.60	6.05	3.41	3.30	17.0	9.6	9.2	2.85	1.80	1.40
1940	52.49	10.61	12.59	10.44	20.2	24.0	19.9	9.02	13.24	8.71
1941	49.66	9.29	11.29	9.79	18.7	22.7	19.7	4.57	4.84	3.22
Total	418.77	90.86	86.59	73.43	------	------	------	63.66	65.46	43.18
Average annual.	41.88	9.09	8.66	7.34	21.7	20.7	17.5	6.37	6.55	4.32

[1] Total annual precipitation as measured by recording rain gage, field C.
[2] Records for 1936 omitted from summary because records for these terraces for the maximum rain of May 8-10, 1936 were lost owing to terrace breaks.

TABLE 23.—*Soil and water losses from terraces of different lengths*

Terrace No.	Interterrace area	Average land slope	Length	Runoff		Soil loss [1] per acre
	Acres	*Percent*	*Feet*	*Inches*	*Percent*	*Tons*
C-10	0.91	6.4	700	10.48	25.6	4.91
C-14	2.19	7.6	1,700	8.37	20.4	6.76
C-17	1.31	7.7	1,100	7.36	17.9	3.10

[1] 9-yr. period, 1931–40. Data for 1936 omitted because records for maximum rain of May 8-10, 1936 were lost owing to breaks in terraces.

All terraces performed satisfactorily up to and including those 1,700 feet in length—the limit of the experiment. Results presented in table 24 show that there is no consistent increase in either soil or water loss per acre with an increase in length, although the peak rate of flow was lower but became more prolonged with increase in length.

Terrace C-13, a 1,700-foot terrace in the grade experiment, had a maximum of 15 inches of water passing through the flume on May 8–10, 1936, which occurred immediately before the terrace broke. Terrace C-14 had a maximum head of 14 inches but suffered no break. This indicates that it is necessary to provide an increased cross-sectional area and greater height in the initial construction and to practice more careful maintenance on terraces exceeding 1,700 feet in length.

TABLE 24.—*Annual runoff and soil loss from the ends of terraces of different lengths, 1931–40*

Year	Total [1] precipitation	Runoff						Soil loss per acre		
		Terrace						Terrace		
		C-10	C-14	C-17	C-10	C-14	C-17	C-10	C-14	C-17
	Inches	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Tons*	*Tons*	*Tons*
1931	34.72	4.07	3.12	2.64	11.7	9.0	7.6	4.22	4.71	2.79
1932	46.22	13.75	11.30	8.56	29.7	24.4	18.5	2.80	4.94	1.73
1933	45.66	12.15	7.38	7.96	26.0	16.2	17.4	6.62	6.75	3.04
1934	35.04	10.99	9.94	7.59	31.4	28.4	21.7	8.02	9.42	4.67
1935	48.57	16.74	14.80	10.30	34.5	30.5	21.2	7.67	11.04	4.87
1936 [2]										
1937	38.64	8.56	6.85	6.10	22.0	17.7	15.8	2.40	3.46	1.28
1938	32.08	7.32	5.91	5.92	22.8	18.4	18.4	3.11	4.56	2.69
1939	35.69	6.37	3.41	3.60	17.8	9.6	10.1	1.92	1.80	1.40
1940	52.49	14.06	12.59	13.53	26.8	24.0	25.8	7.28	13.24	5.26
Total	369.11	94.31	75.30	66.20				44.19	60.82	27.93
Average annual	41.01	10.48	8.37	7.36	25.6	20.4	17.9	4.91	6.76	3.10

[1] Total annual precipitation as measured by recording rain gage, field C.
[2] Records for 1936 omitted from summary because records for these terraces for the maximum rain of May 8–10, 1936 were lost owing to terrace breaks.

Level terraces.—In addition to other terrace experiments, two level terraces were under measurement for the period 1933–41. The performance of several other level terraces of various lengths and vertical intervals was observed during the period of record. The physical characteristics of the two terraces under measurement together with the average soil and water losses recorded are given in tables 25 and 26.

TABLE 25.—*Runoff and soil losses from level terraces*

Terrace no.	Interterrace area	Average land slope	Average vertical interval	Length	Runoff		Soil loss per acre
	Acres	*Percent*	*Feet*	*Feet*	*Inches*	*Percent*	*Tons*
C-3	1.50	4.3	4.0	700	6.52	15.4	3.32
A-3	3.50	4.4	3.0	2,300	3.74	8.9	1.00

TABLE 26.—*Annual runoff and soil loss from level terraces of different lengths for the period, 1933–41*

Year	Total precipitation		Runoff				Soil loss per acre	
	Terrace		Terrace				Terrace	
	C-3	A-3	C-3	A-3	C-3	A-3	C-3	A-3
	Inches	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Tons*	*Tons*
1933	45.66	46.19	4.074	2.160	8.9	4.7	2.233	1.24
1934	35.04	35.73	4.445	1.789	12.7	5.0	3.661	.13
1935	48.57	49.20	11.330	5.207	23.3	10.6	5.273	2.66
1936 [1]								
1937	38.64	37.18	6.226	3.163	16.1	8.5	2.213	.81
1938	32.29	32.35	5.189	5.212	16.1	9.9	2.101	1.16
1939	35.50	34.84	4.180	2.894	11.8	8.3	1.032	.70
1940	52.91	51.76	14.174	6.376	26.8	12.3	9.702	1.04
1941	49.66	50.31	2.518	3.138	5.1	6.2	.311	.52
Total	338.27	337.56	52.142	29.930			26.526	7.96
Average annual	42.28	42.20	6.518	3.742	15.4	8.9	3.316	1.00

[1] Records for 1936 omitted since records for the maximum rain of May 8–10, 1936 were lost owing to terrace breaks.

It will be seen from the characteristics given in table 25 that the two terraces are not directly comparable. However, the information obtained is valuable in evaluating the usefulness of level terraces.

Soil and water losses from A-3, the 2,300-foot level terrace, were lower than for any terrace measured. The losses from C-3 compared favorably with those from C-7, the 700-foot level terrace used in the grade study for short terraces, and were less than those from terraces with a minimum grade.

Experience with open-end level terraces under observation has shown that some damage to growing crops in the channel will occur during periods of heavy rainfall. The condition giving rise to this one objection has not occurred frequently enough, however, to preclude entirely the use of level terraces, although it would probably be more serious if such terraces were used on thin soils such as the Kirvin having a tight, impervious subsoil.

Some trouble was encountered with breaks in the 2,300-foot level terrace, although this occurred only about four times during the period of record. General observations have indicated that much more care will be required in building and maintaining level terraces than graded terraces, and that these terraces should be used only on gentle, well-drained slopes having a deep, permeable soil, such as Norfolk.

During the early years of the station, several closed-end, level terraces, encircling a knoll, were constructed in field A. They were used with fair success during 1931 but all overtopped during the 5.94-inch rain of January 4, 1932. Damage to the field from these breaks was excessive and proved conclusively that closed-end, level terraces were not practicable for much of the area served by the station. The character of the rainfall is such that it is not possible to retain all of the water that falls. During periods of high or intense rainfall, it is essential that a part of the water be permitted to escape as runoff.

Review of terracing experiments.—Comparison of the amount of material removed by erosion from terraced and unterraced areas serves a valuable purpose in indicating the effectiveness of control by terracing. It should be clearly recognized, however, that under the experimental technique used, the two measurements were not precisely comparable. Records of losses of soil from the ends of terraces are very useful in comparing the effectiveness of terraces of different types, sizes, and gradients. In comparing such records, however, the surface configuration of the interterrace areas and the distances between the terrace ridges must be taken into consideration.

Unterraced areas were measured as closed watersheds; that is, there was no way for eroded material carried to the lower parts of the areas to escape except through the measuring devices. The drainage areas formed by the terrace ridges—the interterrace areas—however, were not entirely closed. That is, a considerable portion of the soil eroded from the upper parts of these interterrace areas was deposited in the terrace channels and did not pass on with the runoff through the measuring devices at the ends of the terraces. Under some systems of terrace maintenance, part of the soil deposited in the channels is periodically moved up and over the terrace ridges. From the lower sides of the ridges this is eventually eroded into the next terrace channel downslope. Over a long period, this cycle of erosion, deposition, and transposition through maintenance operations is usually repeated many times. As a result a continuing downslope movement of soil takes place, varying in amount from an insignificant minimum on gently sloping soils of favorable porosity to a serious maximum on steep, highly erodible soils of low absorptive capacity. Obviously this movement or type of loss was not measured by the devices placed at the ends of the terrace channels.

The magnitude of the loss occasioned by the transverse movement of soil over the terrace ridges is difficult to determine and as yet has not been determined. Through the adoption of a maintenance system in which the soil deposited in the channel is plowed upslope, the soil movement by erosion across the terrace interval may be greatly reduced; and, of course, good rotations, the use of seasonal cover crops, strip cropping, and other soil-stabilizing measures still further reduce the losses.

No terracing experiments were set up for the specific purpose of measuring the effectiveness of the performance of the terracing system as a whole; however, the results of the various experiments on the physical characteristics of terraces, together with observations and experience on the construction, maintenance, and outlet protection problems, have furnished sufficient basic information to design an efficient and satisfactory terrace or terrace system. Results from gaging station 4, at the outlet of an unterraced cultivated watershed located adjacent to field C with similar soils, slope, and cropping treatments, were used in evaluating the effectiveness of terracing in conserving soil and water. Over the period of record this area lost an average of 48 tons of soil annually and 20 percent of the total rainfall. The effectiveness of terracing in conserving soil is clearly demonstrated when these losses are compared with those from the terraces in field C having grades not exceeding 3 inches per 100 feet.

The grade studies at this station together with observations show that grades along the terrace channel should be held below 3 inches per 100 feet if excessive soil loss is to be avoided. The question of choosing the most desirable grade for a given terrace will depend upon several factors. Of these, drainage and soil type are perhaps the most important and the grade selected should be such as to meet the particular requirements of the location. If terraces are to be used in fields having a deep, porous soil, less grade will be required than on steep, rocky fields or on areas having an impervious subsoil. Level terraces should be used only in those areas having a deep, porous soil and much care should be exercised in their construction and maintenance. In case of doubt as to the absorptiveness of the soil, it would be well to give the terrace a slight grade, but great caution should be exercised in recommending grades exceeding 3 inches per 100 feet.

Vertical interval is an important factor in terracing in that it governs largely the per-acre cost of terrace construction. It is therefore desirable to space the terraces as far apart as possible without frequent taxing of the terrace to capacity by runoff resulting from the larger drainage area. The most satisfactory spacing would be one which permitted the construction of as few terraces as possible to handle properly the runoff water and hold interterrace erosion to a minimum. The experiment on the vertical interval of terraces showed that some gullying occurred in the intervals of the 4- and 5-foot terraces but was not reflected in the total soil loss measured. Observation of 6-, 7-, and 8-foot vertical interval showed that gullying became excessive when the vertical interval exceeded 5 feet. The 3- and 4-foot vertical spacings gave the most satisfactory results and spacings exceeding 4 feet should be used only in exceptional cases. In general, spacings recommended by Ramser (*12*) and Hamilton (*9*) have given satisfactory results. Bentley's "rule of the thumb" (*6*) also gives satisfactory results by changing the constant used in the rule from 2 to 2½ on slopes exceeding 5 percent.[5]

There was no appreciable difference in the soil and water losses from terraces of different lengths, but the 1,700-foot and 2,300-foot terraces overtopped during the maximum rain of May 8–10, 1936. The 2,300-foot terrace overtopped several times during the period of record. These observations indicate that terraces over 1,500 feet in length require a greater cross section than shorter terraces and that a greater maximum effective height will have to be maintained. However, owing to the numerous small fields in the region, it is believed that very few terraces will exceed 1,500 feet in length. It is recommended therefore that the length of the terrace be governed by the location of a suitable outlet.

Since very little multiple-row farm machinery is used within the region, the most desirable and efficient size of terrace would have a base width of approximately 20 feet, an effective height of not less than 15 inches, and length not exceeding 1,500 feet. If tractor or multiple-row farm machinery is to be used, an increased base width, however, will be required for satisfactory operation. Base widths of less than 20 feet are not recommended since it is difficult to maintain the necessary height on the narrow terrace widths, especially on the more sandy soils.

Under the prevailing farming practices followed on the station, terraces required only occasional maintenance other than that provided by regular farming operations. The frequence of such maintenance will depend largely upon the care exercised during the course of farming operations. The use of a two-way plow in which all of the soil was turned uphill, leaving the dead furrow in the terrace channel, assisted materially in keeping maintenance costs down. This is similar to the method developed by Downing and Price (*8*).

While the initial cost of terracing has generally been considered rather high, experience has shown that the cost per year of the protection provided is very reasonable. For example, the terraces on field A of the station were constructed at a total cost of $4.56 per acre, which is less than the total cost of seeding an acre of vetch. In general, terracing has proved to be a very satisfactory method of erosion control for cultivated lands in this region. Experience has shown that terraces may be used successfully as a permanent method of erosion control throughout the region if suitable outlets are provided and the terraces are properly constructed and maintained. Many terrace failures have occurred mainly because they were used as a reclamation measure rather than an erosion-control measure. Terraces should not be expected to reclaim steep, gullied fields that have little or no soil to protect; and, in general, such attempts will result in failure, unless accompanied by fertilization and other soil improvement practices.

Gully and terrace outlet control.—The mechanical structures or dams used in the experiments in gully and terrace-outlet control were divided into two distinct types. Temporary dams include those constructed from brush, poles, woven wire, or loose rock, used primarily in gullies prior to the installation of a more permanent erosion-control measure or

[5] For the Southern States the approximate vertical interval in feet can be determined by dividing the slope by 4 and adding 2 to the quotient.

to assist in establishing vegetative cover. Permanent structures, usually of concrete or rock masonry, are used only in locations where permanent control is desired, as in terrace-outlet ditches.

Brush and woven wire dams performed satisfactorily where the height of the dam did not exceed 2 feet. Where these materials were used for high dams, considerable difficulty was experienced in preventing the water from cutting around the sides, or being forced through the dam. Damage from undercutting was also experienced when dams of this type, greater than 2 feet in height, were used.

Loose rock dams were unsatisfactory as runoff from intense rains removed the smaller rocks and cut through the dam. The average useful life of the brush and woven wire dams was 1 to 2 years, depending upon the quality of the materials used. Dams constructed of poles were more durable than brush and woven wire dams, although the expense of construction was somewhat higher than that of brush and woven wire. Satisfactory results were obtained from all the pole dams up to 4 feet in height. Dams exceeding 4 feet were made to hold satisfactorily but required more care in construction and considerable maintenance before the fill became well consolidated. Pole dams had an average useful life of 4 to 5 years, depending, of course, upon the type of timber used.

Concrete, rock masonry, or patented sheet metal structures in terrace-outlet ditches or drainageways gave excellent results where correctly designed and constructed. Although the original cost of these structures was rather high, they required no maintenance after the fill became settled. This was true of all dams of this type including those up to 6 feet in height. Where native rock and sand are available without cost, the rock masonry is probably the cheapest to build and the most satisfactory.

Sod-bag dams were not considered satisfactory because of undercutting which resulted in collapse of the center section of the dam before the sod became established. Considerable difficulty was experienced in establishing vegetation in gullies owing to the lack of fertility of the subsoil. Heavy applications of fertilizer were required in all instances to obtain a satisfactory growth. Since it was necessary to initiate the establishment of vegetation during the spring and summer months, frequent intense rains caused much damage to newly sodded ditches resulting in high maintenance costs. In general, vegetation alone has not proved satisfactory as a permanent control measure for active gullies and terrace-outlet ditches and should be considered as only a temporary measure.

Contour backfurrows on pasture land.—The effect of contour backfurrows in conserving runoff from permanent pastures was tried on several different areas of the station. Measurements of soil and water losses from these areas were not obtained and their performance was of necessity evaluated by observation.

The backfurrows were constructed on 1-foot contour intervals with a long-wing terracing plow. On one small area, fills were made across the smaller gullies as in terrace construction.

Experience indicated that this method assisted in retaining runoff during the period of establishment of pastures. However, results from the Bermuda grass control plots indicated that backfurrows on well-established pastures are not required. Mowing was found difficult and expensive over the backfurrows. Since periodic mowing to control weeds and other undesirable growth is essential to pasture management, this difficulty probably offsets any benefit received from the backfurrows.

Soil movement studies.—The changes in soil movement resulting from 6 years of operations on the terraces in field C are shown in figure 20. It will be noted that the more pronounced changes have occurred in the terrace ridges and channels and are the result of terrace maintenance and the use of the two-way plow in which all soil is turned uphill. With this method of plowing, the dead furrow is left in the terrace channel and tends to maintain the channel capacity of the terrace. Additional maintenance was accomplished by the use of the blade grader on the upper side of the terrace only. It should also be noted that the terrace ridges and channels moved uphill to some degree during the course of the experiment. This was partly due to the method of plowing used and the more intensive maintenance given these terraces during the fall of 1937.

There was little change in the upper portion of the terrace interval; however, there is some indication that the practice of turning the soil uphill every year, by the use of the two-way plow, will counteract in some degree the movement of soil downhill by erosion.

Watershed Studies

Results from studies of three small watersheds for the period 1933–41 demonstrated further the effectiveness of plant cover in controlling erosion. Gaging station No. 4 of the unterraced, cultivated watershed showed an average loss of 48.0 tons of soil annually, compared with 10.93 tons from the strip-cropped watershed, and .06 ton from the wooded watershed. Although the unterraced and strip-cropped watersheds are not precisely comparable as to soil and slope, the losses from these two areas are useful in evaluating the effectiveness of different control measures.

Losses from gaging station No. 4 may be compared with those from the terraces in field C to assist in determining the effectiveness of terracing and with those from gaging station No. 3 to determine the effec-

TABLE 27.—*Annual runoff and soil loss from small watersheds of different characteristics*

Year	Total precipitation[1]	Runoff						Soil loss per acre		
		Watershed						Watershed		
		Gaging station 3, wooded	Gaging station 4, unterraced	Gaging station 5, strip-cropped	Gaging station 3, wooded	Gaging station 4, unterraced	Gaging station 5, strip-cropped	Gaging station 3, wooded	Gaging station 4, unterraced	Gaging station 5, strip-cropped
	Inches	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Tons*	*Tons*	*Tons*
1933	45.66	0.23	7.59	7.28	0.5	16.5	16.0	0.03	41.03	12.33
1934	35.04	2.95	7.11	8.33	8.4	20.3	23.8	.04	59.77	.48
1935	48.57	1.72	11.52	8.25	3.5	23.7	17.0	.08	73.71	2.76
1936[2]										
1937	38.64	.07	4.89	4.76	.2	12.7	12.3	.02	12.15	8.02
1938	32.08	1.15	4.74	4.82	3.6	14.8	15.0	.14	15.09	1.81
1939	35.69	.49	4.90	2.55	1.4	13.9	7.1	.03	23.43	2.80
1940	52.49	2.09	14.31	15.84	4.0	27.3	30.2	.08	104.65	26.48
1941	49.66	.85	12.86	15.05	1.7	25.9	30.3	.02	54.26	32.73
Total	337.83	9.55	67.92	66.88				.44	384.08	87.41
Average annual	42.23	1.19	8.49	8.36	2.8	20.1	19.8	.06	48.01	10.93

[1] Total precipitation as measured by recording gage, field C.
[2] Records for 1936 omitted because several records for these areas were lost while installations were being replaced.

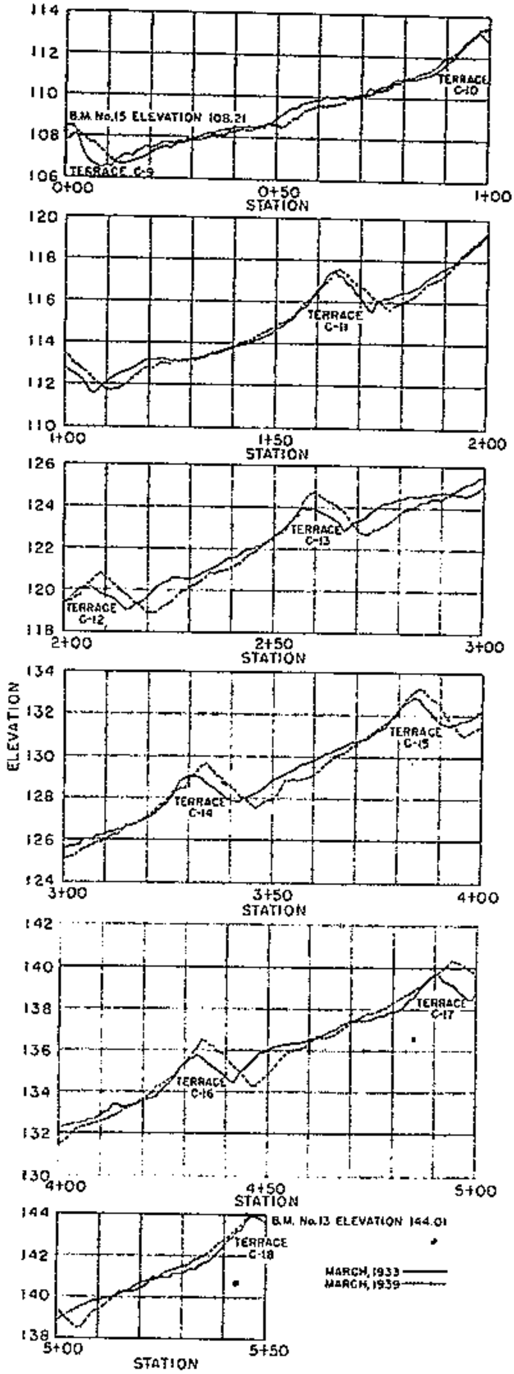

FIGURE 20.—Changes in soil movement resulting from 6 years of operations on the terraces in field C.

tiveness of forest cover. Losses from the three watersheds are given in table 27. Hydrologic studies in connection with these watersheds have been reported elsewhere. [6]

Discussion of Experimental Results

Erosion in the Sandy Lands Region is caused for the most part by surface runoff. Wind causes a small amount of erosion during the spring months on open, bare, sandy fields, though the damage is of small consequence in comparison with the amount of damage resulting from rainfall. Studies of the relationship of rainfall to soil losses on the control plots show that soil type, length and degree of slope, state of cultivation, and surface cover are basic factors directly influencing the rate and amount of runoff and soil loss. The length of slope did not materially affect the amount of surface runoff, but an increase in slope length increased the soil loss resulting from the runoff. The same was true of the degree of slope—there was very little difference in total amount of surface runoff but a very pronounced increase in soil loss with an increase in the degree of slope from areas under cultivation. This did not hold true for well-sodded Bermuda grass areas, which indicates rather definitely that the kind of crop to be grown determines largely the degree of slope which may be used without excessive soil losses. Vegetative cover was shown to be effective in reducing runoff and especially soil loss under the same soil type, slope, and rainfall. The degree of control secured from vegetal cover was dependent upon the type of vegetation used, the season of the year, and the length of time it occupied the land.

The average monthly rainfall distribution for the period of record shows that there is sufficient rainfall throughout the year to produce erosion during any month of the year on unprotected land. Sixty percent of the total soil loss for the period of record was caused by 10 percent of the storms causing soil loss. One or more of these storms occurred during each month except August and September. The period of greatest frequency was during the months of May, June, and July. Single storms where high intensities occur may remove as much soil as is lost during the entire year from all other storms. An average of 2.2 storms of disastrous nature occurred during the 10-year period but the number for any individual year varied from none to as many as six. This type of storm has been the cause of the major soil erosion problem of the area, and it is against these storms that methods of erosion control should be designed and rated for efficiency. Various supplemental erosion-control measures including contour tillage, cover crops, frequent cultivation, and alternate strips of erosion-resistant crops have all decreased erosion and have been effective during light storms but have not furnished adequate protection during the critical storms.

The results secured from 10 years' experimentation at the station have shown that erosion control can be secured on erodible lands of the region if they are placed under permanent cover of grass or forest, but that sloping, intensively cultivated fields require not only the use of improved rotations and protective winter cover crops but the additional

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[6] WORD, O. C., JR. HYDROLOGIC STUDIES—COMPILATION OF RAINFALL AND RUNOFF DATA FROM THE WATERSHEDS OF THE ARK.-LA.-EAST TEXAS SANDY LANDS CONSERVATION EXPERIMENT STATION, TYLER, TEXAS, 1931–39. U. S. Dept. Agr. Soil Conserv. Serv.-TP-41, 21 pp. illus. 1941. [Processed.]

support of terraces. This condition will hold true as long as the prevailing agriculture of the region remains primarily one of growing cotton, corn, and truck crops that require intensive cultivation, which is conducive to soil erosion.

The need for terracing and terrace maintenance in the area will make the progress of erosion control slower than if purely vegetative control measures could be used.

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APPENDIX

The data presented in appendix tables 28 to 37 will probably be of little interest to the casual reader, but since they present the detailed records of precipitation, runoff, erosion, and similar data for the 10-year period, they will be of much value and interest to the technical worker.

TABLE 28.—*Rainfall, 1931–40,* [1] *and the average rainfall, 1905–40* [2]

Month	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	10-year average [1]	36-year average [2]
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January	1.64	10.13	5.01	2.80	3.48	0.91	6.42	5.14	5.03	1.10	4.17	3.43
February	3.46	6.43	1.74	2.96	3.60	1.09	1.61	1.84	7.56	3.68	3.29	3.31
March	3.19	2.92	4.99	5.51	2.36	1.43	4.08	4.39	1.44	2.21	3.65	3.83
April	2.81	3.44	4.30	8.90	5.04	3.59	2.00	4.00	2.61	4.22	3.95	4.71
May	1.47	1.53	4.44	.90	8.46	7.32	.73	1.75	3.13	4.28	3.40	4.09
June	4.13	1.61	0	1.46	3.03	0	3.30	3.85	2.73	6.03	2.07	2.90
July	2.86	2.87	4.96	.52	2.73	4.49	2.53	.80	3.38	3.60	2.87	3.33
August	3.28	1.17	4.44	.89	1.20	.46	2.87	2.21	1.23	5.00	2.34	2.45
September	.17	2.78	4.06	2.18	3.43	2.61	1.23	.66	.03	3.22	2.04	2.41
October	2.59	2.38	1.58	.32	6.28	5.23	2.02	.49	2.13	5.20	2.82	3.14
November	3.68	.85	.89	5.94	4.65	1.96	5.04	4.16	5.22	8.73	4.11	4.03
December	6.82	10.60	7.88	2.80	4.12	5.08	6.09	3.14	2.65	5.27	5.45	4.75
Total	36.10	46.71	44.29	35.18	48.48	34.17	36.52	32.43	37.14	53.02	40.66	42.38

[1] Records of project 1, control-plot gage, Soil and Water Conservation Experiment Station, Tyler, Tex.
[2] Records of Texas Agricultural Experiment Substation No. 2, Tyler, Tex.

TABLE 29.—*Monthly and annual temperature records, 1931–40* [1]

Month	1931		1932		1933		1934		1935		1936		1937		1938		1939		1940		10-year average	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
January	69	24	75	25	74	25	75	23	78	13	75	15	71	21	76	21	72	27	72	4	73.7	19.8
February	71	33	83	26	78	3	77	24	76	24	76	11	78	28	79	22	75	20	83	25	77.6	21.6
March	79	28	85	20	86	28	82	26	87	32	90	39	77	28	86	35	81	31	84	26	83.7	29.3
April	83	34	84	41	87	36	86	44	89	40	91	32	88	38	84	33	87	35	86	29	86.5	36.2
May	86	43	89	56	90	52	93	53	88	49	84	57	93	51	90	45	90	52	87	50	89.0	50.8
June	94	55	96	65	100	55	97	64	91	62	98	63	99	62	91	65	97	66	93	58	95.6	61.5
July	98	66	101	69	105	67	104	70	99	67	93	63	99	67	99	69	101	65	96	62	99.5	66.5
August	96	60	100	65	93	68	102	69	104	61	107	61	102	68	99	70	103	65	97	58	100.3	64.5
September	95	54	98	58	95	61	96	52	92	51	95	52	99	50	97	51	105	50	94	46	96.6	52.5
October	91	39	87	38	89	43	90	49	88	45	85	42	92	32	100	31	95	37	88	40	90.5	39.6
November	80	40	79	21	88	35	84	32	81	30	79	28	84	23	84	23	80	30	77	20	81.6	28.2
December	78	32	76	10	81	30	72	22	67	19	71	26	72	19	78	23	81	21	71	27	74.7	22.9
Annual	98	24	101	10	105	3	104	22	104	13	107	11	102	19	100	21	105	20	97	4	----------	----------

[1] Data from the Texas Substation No. 2, Tyler, Tex.

TABLE 30.—*Soil loss in runoff from control plots by individual rains, 1931–40*

[8.75-percent slope, Kirvin fine sandy loam]

Date of rains producing runoff	Amount of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre
1931	*Inches*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Apr. 20	0.98	268.0	147.5	250.0	420.0	183.0	295.0	410.0	90.0	440.0	116.0	75.0	182.0
Apr. 29	1.22	0	0	0	0	0	0	32.0	0	54.0	0	0	0
May 3	.30	438.0	395.0	493.0	412.0	328.0	268.0	247.0	23.0	259.0	71.0	21.0	34.0
May 19	.54	0	0	0	0	0	0	0	0	328.0	0	0	0
June 13	1.69	3,400.0	8,755.0	5,950.0	5,140.0	5,820.0	5,745.0	884.0	98.0	3,595.0	13,090.0	9,500.0	8,500.0
June 16–17	2.40	10,900.0	27,600.0	19,400.0	16,520.0	18,430.0	17,150.0	1,770.0	610.0	9,590.0	24,530.0	29,600.0	22,350.0
July 29-30-31	1.14	168.0	113.5	206.0	145.0	136.0	1,809.0	35.0	5.0	1,545.0	5,300.0	3,640.0	6,301.0
Aug. 19	1.84	584.0	1,026.5	1,129.0	760.0	914.0	2,293.0	17.0	9.0	1,731.0	9,720.0	11,430.0	12,720.0
Aug. 21	.35	108.0	247.0	179.0	161.0	169.0	750.0	0	0	410.0	1,810.0	1,990.0	2,280.0
Aug. 29	.53	58.0	155.0	99.0	70.0	81.0	835.0	0	0	89.0	1,562.0	1,410.0	2,224.0
Oct. 15	.45	434.0	475.5	575.0	485.0	756.0	3,920.0	14.0	0	1,328.0	4,510.0	2,715.0	7,090.0
Oct. 23	1.46	46.2	82.0	105.0	67.5	71.3	145.0	68.3	0	202.0	101.0	3,140.0	3,850.0
Oct. 28	.40	20.0	10.5	35.0	15.0	0	35.0	18.0	0	50.0	56.0	1,032.0	1,292.0
Nov. 17	.35	0	0	0	0	0	0	0	0	10.0	10.0	280.0	360.0
Nov. 19	.90	700.0	1,345.0	1,950.0	940.0	2,000.0	4,400.0	850.0	0	2,580.0	8,540.0	18,950.0	18,600.0
Nov. 26	.67	0	0	0	0	0	0	0	0	6.0	66.0	332.0	449.0
Nov. 28–29	1.30	80.0	110.5	152.0	102.0	230.0	409.0	93.0	0	456.0	4,680.0	4,680.0	4,255.0
Dec. 1	1.10	54.0	58.0	49.0	78.0	88.0	133.0	49.0	0	122.0	3,020.0	2,240.0	1,350.0
Dec. 12	.52	284.0	590.0	636.0	347.0	960.0	1,286.0	533.0	0	1,190.0	4,740.0	7,290.0	6,970.0
Dec. 16–17	2.07	40.0	135.0	90.0	60.0	180.0	520.0	90.0	0	240.0	4,300.0	3,980.0	2,900.0
Dec. 18	.50	0	0	0	0	0	0	0	0	0	120.0	150.0	80.0
Dec. 19	.52	0	6.0	0	0	0	56.0	0	0	34.0	486.0	885.0	839.0
Dec. 23	.23	0	0	0	0	0	180.0	0	0	0	960.0	1,320.0	1,520.0
Dec. 30	1.03	1,358.0	1,770.0	2,079.0	2,150.0	2,420.0	2,600.0	1,180.0	11.0	4,710.0	5,200.0	11,280.0	15,960.0
1932													
Jan. 4	5.67	1,868.0	2,630.0	3,870.0	4,340.0	2,980.0	3,780.0	1,150.0	5.0	6,690.0	16,800.0	34,700.0	29,200.0
Jan. 11	2.02	142.0	238.0	375.0	349.0	206.0	540.0	89.0	0	766.0	1,585.0	2,398.0	1,280.0
Jan. 15	.54	0	0	0	0	0	0	0	0	0	203.0	162.0	423.0
Jan. 17	.32	0	0	0	0	0	0	0	0	0	226.0	380.0	585.0
Jan. 25	.83	0	0	0	0	0	0	0	0	0	39.0	34.0	55.0
Jan. 29	.42	0	0	0	0	0	0	0	0	0	30.0	10.0	50.0
Feb. 16	.47	0	60.0	0	0	0	0	0	0	0	420.0	510.0	1,110.0
Feb. 18–19	1.93	0	0	0	0	0	0	0	0	0	480.0	2,220.0	2,380.0
Feb. 20	.86	0	60.0	110.0	140.0	70.0	180.0	0	0	190.0	570.0	2,140.0	2,080.0
Mar. 3	1.45	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

Mar. 4	1.42	0	0	0	0	0	0	0	0	0	820.0	1,400.0	1,910.0
May 8	.49	0	0	0	0	0	740.0	0	0	0	0	0	0
May 15	1.04	904.0	472.5	562.0	397.0	658.0	345.0	376.0	0	525.0	0	0	0
June 25	1.19	2,380.0	5,600.0	1,780.0	2,080.0	1,760.0	1,810.0	3,780.0	0	910.0	0	0	0
July 6	.96	800.0	890.0	2,080.0	420.0	2,780.0	1,140.0	390.0	0	1,270.0	650.0	670.0	280.0
July 22	1.47	9,520.0	27,450.0	12,080.0	12,270.0	9,100.0	2,910.0	9,250.0	160.0	3,820.0	19,420.0	17,350.0	24,400.0
Aug. 18	.28	0	525.0	220.0	330.0	360.0	0	0	0	0	240.0	0	1,120.0
Sept. 4	2.30	0	0	0	0	0	0	0	0	0	1,700.0	350.0	4,740.0
Oct. 4	.72	0	1,670.0	430.0	550.0	1,080.0	0	600.0	0	570.0	4,810.0	2,380.0	6,290.0
Oct. 25	.91	0	375.0	0	0	0	0	0	0	0	0	1,200.0	2,170.0
Nov. 23	.63	640.0	330.0	0	180.0	230.0	190.0	190.0	0	190.0	70.0	1,060.0	2,530.0
Dec. 9	.44	0	0	0	0	0	0	0	0	0	0	0	348.0
Dec. 23	1.43	4,120.0	30,750.0	8,410.0	10,100.0	9,240.0	5,710.0	13,180.0	0	5,930.0	32,390.0	43,700.0	45,000.0
Dec. 29-30	4.91	4,360.0	17,500.0	5,050.0	7,310.0	7,280.0	5,950.0	7,220.0	20.0	5,440.0	32,250.0	24,230.0	21,450.0
1933													
Jan. 7	2.55	0	210.0	0	0	0	0	0	0	0	1,690.0	220.0	500.0
Jan. 21	1.18	730.0	4,070.0	780.0	1,011.0	1,105.0	781.0	979.0	0	591.0	4,603.0	4,917.0	5,064.0
Jan. 31	.75	0	221.0	110.0	113.0	100.0	136.0	76.0	0	0	2,184.5	767.0	1,251.0
Feb. 7	.42	0	329.5	105.0	163.0	210.0	202.0	105.0	0	84.0	1,082.0	735.0	428.0
Mar. 18	.85	314.0	1,010.0	272.0	212.0	732.0	227.0	256.0	0	181.0	671.0	556.0	395.0
Mar. 24	1.01	716.0	6,975.0	2,100.0	1,440.0	2,975.0	1,165.0	3,840.0	0	902.0	5,700.0	6,660.0	8,880.0
Mar. 30	1.71	2,400.0	21,150.0	3,425.0	5,222.0	9,670.0	2,480.0	15,520.0	45.0	3,342.0	16,480.0	25,200.0	27,050.0
Apr. 13	.90	0	0	0	0	725.0	0	0	0	0	0	0	0
Apr. 20	.40	0	0	0	385.0	570.0	250.0	0	0	0	0	0	0
Apr. 25-26	2.09	9,300.0	12,100.0	10,320.0	6,860.0	8,500.0	7,550.0	8,820.0	8.0	4,005.0	6,590.0	6,840.0	9,290.0
Apr. 29	.69	1,634.0	2,170.0	2,135.0	814.0	890.0	741.0	1,311.0	0	168.0	760.0	724.0	1,048.0
May 4	1.00	788.0	800.0	1,530.0	798.0	1,083.0	341.0	150.0	0	348.0	0	0	0
May 21	.63	2,540.0	2,820.0	4,340.0	1,660.0	1,010.0	1,740.0	1,080.0	0	140.0	1,580.0	1,450.0	880.0
May 24-25	2.30	7,160.0	20,300.0	9,980.0	6,500.0	2,930.0	7,430.0	5,840.0	5.0	1,808.0	19,150.0	15,750.0	17,400.0
July 15	.78	0	180.0	0	0	0	0	0	0	100.0	0	0	0
July 19	2.83	1,820.0	1,880.0	2,340.0	2,320.0	740.0	770.0	2,110.0	0	890.0	7,800.0	7,190.0	7,800.0
Aug. 12-13	1.55	778.0	1,620.5	1,019.0	435.0	0	378.0	466.0	0	193.0	7,970.0	6,350.0	4,460.0
Aug. 17	.56	0	0	0	0	0	0	126.0	0	0	0	0	0
Aug. 25	1.07	528.0	498.5	567.0	221.0	0	280.0	462.0	0	203.0	4,630.0	2,860.0	3,065.0
Sept. 9-10-11-12	3.27	3,460.0	3,880.0	3,860.0	2,540.0	5.0	1,870.0	1,060.0	0	2,260.0	38,810.0	32,210.0	36,000.0
Sept. 27	.60	0	0	0	0	6	0	0	0	0	1,295.0	910.0	1,405.0
Oct. 12	.78	0	0	0	0	0	0	0	0	0	570.0	340.0	562.0
Nov. 3	.89	0	0	0	0	0	0	0	0	0	0	195.0	248.0
Dec. 2	1.36	334.0	455.0	775.0	322.0	218.0	340.0	320.0	0	348.0	183.0	7,430.0	6,850.0
Dec. 15-16	3.94	1,030.0	1,517.5	1,198.0	1,620.0	225.0	805.0	331.0	0	1,490.0	2,540.0	26,000.0	25,680.0
Dec. 28-29-30	2.44	46.0	46.5	46.0	110.0	0	35.0	15.0	0	83.0	183.0	1,980.0	1,780.0
1934													
Jan. 3	1.40	0	87.5	0	143.0	0	0	0	0	115.0	173.0	1,758.0	1,738.0
Feb. 18	1.01	332.0	120.0	184.0	229.0	0	121.0	63.0	0	141.0	140.0	1,132.0	1,485.0
Feb. 28, Mar. 1, 2, 3, 4	3.61	178.0	63.5	396.0	337.0	89.0	344.0	278.0	0	93.0	805.0	5,510.0	4,960.0
Mar. 24, 25	3.94	366.0	325.5	255.0	403.0	87.0	511.0	1,125.0	16.0	308.0	996.0	8,110.0	7,800.0
Apr. 5	4.15	3,640.0	5,890.0	2,940.0	3,960.0	1,600.0	2,470.0	3,260.0	30.0	610.0	2,820.0	6,280.0	4,760.0
Apr. 16	.75	600.0	1,360.0	410.0	590.0	350.0	420.0	460.0	0	30.0	150.0	170.0	160.0
Apr. 24	1.56	8,120.0	28,550.0	11,400.0	14,510.0	4,850.0	13,760.0	5,910.0	40.0	2,660.0	17,620.0	18,250.0	21,470.0
June 12	.97	744.0	943.5	1,190.0	1,319.0	912.0	795.0	612.0	0	372.0	854.0	898.0	661.0
Aug. 14	.62	1,708.0	6,365.0	3,400.0	3,726.0	3,400.0	2,142.0	308.0	0	638.0	1,134.0	2,832.0	2,145.0

TABLE 30.—*Soil loss in runoff from control plots by individual rains, 1931–40*—Continued

[8.75-percent slope; Kirvin fine sandy loam]

Date of rains producing runoff	Amount of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre
1934—Contd.	*Inches*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Sept. 14	.94	904.0	5,719.5	1,755.0	2,025.0	147.0	219.0	0	0	434.0	979.0	3,932.0	4,692.0
Nov. 19	1.92	3,180.0	10,250.0	6,850.0	7,600.0	3,160.0	2,480.0	2,780.0	0	1,250.0	12,450.0	20,200.0	16,800.0
Nov. 20, 21	1.72	460.0	1,120.0	586.0	540.0	190.0	150.0	120.0	0	60.0	3,580.0	4,300.0	3,540.0
Nov. 29	1.32	400.0	785.0	540.0	500.0	220.0	190.0	300.0	0	90.0	1,910.0	2,340.0	2,280.0
Dec. 2	1.81	3,900.0	9,540.0	6,840.0	6,030.0	3,200.0	2,910.0	3,070.0	0	1,310.0	10,780.0	16,500.0	14,610.0
1935													
Jan. 7	.90	0	0	0	0	0	0	0	0	0	326.0	1,410.0	707.0
Jan. 19–20	2.58	3,198.0	13,410.0	10,470.0	6,200.0	2,800.0	1,448.0	3,190.0	0	812.0	6,000.0	17,000.0	13,920.0
Feb. 8	2.04	1,488.0	9,050.0	5,990.0	2,710.0	831.0	377.0	956.0	9.0	284.0	3,180.0	6,385.0	4,910.0
Mar. 4	1.40	1,342.0	6,635.0	7,200.0	3,304.0	535.0	324.0	1,278.0	24.0	184.0	4,500.0	8,650.0	7,585.0
Mar. 6	.48	322.0	947.5	681.0	452.0	162.0	171.0	123.0	0	0	803.0	1,230.0	1,700.0
Apr. 20	.77	344.0	109.0	219.0	0	460.0	0	212.0	0	328.0	197.0	0	0
Apr. 25–26	2.47	3,500.0	2,000.0	1,945.0	2,240.0	4,200.0	2,962.0	1,820.0	0	2,795.0	1,310.0	1,350.0	912.0
Apr. 28	.52	1,940.0	1,810.0	990.0	2,180.0	2,860.0	2,160.0	1,480.0	4.0	1,430.0	1,488.0	1,350.0	946.0
May 2–5	5.52	17,000.0	30,400.0	12,300.0	23,150.0	20,100.0	18,180.0	16,170.0	24.0	16,460.0	20,200.0	24,020.0	27,010.0
May 15	1.18	4,710.0	5,035.0	6,740.0	2,000.0	4,480.0	3,325.0	3,980.0	3.0	2,870.0	1,680.0	1,233.0	448.0
May 18–19	1.59	1,014.0	1,940.0	2,352.0	800.0	1,097.0	775.0	1,301.0	0	378.0	1,807.0	1,227.0	645.0
June 17	1.21	2,120.0	1,655.0	1,090.0	630.0	1,580.0	1,060.0	1,930.0	0	1,060.0	2,105.0	1,530.0	977.0
June 21	.42	424.0	442.5	277.0	78.0	369.0	237.0	442.0	0	496.0	468.0	96.0	143.0
July 2	.51	0	0	0	0	240.0	95.0	0	0	0	0	0	0
July 3	1.23	6,560.0	24,160.0	13,700.0	10,300.0	10,700.0	3,060.0	13,570.0	0	10,180.0	16,930.0	13,400.0	14,400.0
July 21	.50	770.0	570.0	1,000.0	220.0	948.0	104.0	310.0	0	1,160.0	164.0	242.0	175.0
Aug. 14	1.02	832.0	747.5	453.0	53.0	4,443.0	642.0	988.0	0	2,662.0	4,495.0	1,565.0	40.0
Sept. 8	1.01	0	0	0	0	117.0	0	0	0	0	158.0	0	0
Sept. 9	.37	0	85.0	43.0	0	503.0	29.0	0	0	279.0	1,360.0	559.0	0
Sept. 24–25	1.60	358.0	2,288.0	996.0	47.0	1,790.0	138.0	1,022.0	0	5,192.0	7,188.0	6,100.0	67.0
Oct. 18	.38	0	0	0	0	0	0	0	0	0	244.0	121.0	0
Oct. 22–23	1.95	172.0	71.0	91.0	32.0	182.0	112.0	77.0	0	587.0	106.0	2,148.0	52.0
Oct. 27	3.34	2,442.0	5,320.0	2,210.0	943.0	9,410.0	6,590.0	8,110.0	0	14,870.0	20,170.0	28,700.0	14,590.0
Nov. 1	.28	0	0	0	0	115.0	31.0	0	0	119.0	424.0	615.0	297.0
Nov. 4	.52	32.0	46.0	31.0	0	315.0	147.0	167.0	0	287.0	737.0	915.0	551.0
Nov. 9–10–11	2.76	2,218.0	4,676.0	1,783.0	414.0	7,220.0	4,595.0	7,720.0	0	13,520.0	13,860.0	20,530.0	11,260.0
Nov. 26	.99	224.0	232.5	187.0	45.0	537.0	270.0	498.0	0	1,060.0	1,052.0	2,420.0	857.0
Dec. 5–6	3.66	508.0	975.0	545.0	155.0	1,670.0	890.0	1,790.0	0	3,160.0	6,855.0	7,890.0	7,670.0

1936													
Mar. 24	.73	616.0	690.0	600.0	296.0	528.0	652.0	708.0	13.0	3,240.0	3,980.0	7,600.0	5,490.0
Apr. 28	3.00	4,852.0	4,527.5	4,297.0	3,785.0	1,456.0	4,062.0	3,023.0	0	3,415.0	5,133.0	1,153.0	900.0
May 8-9-10	5.06	48,662.0	88,982.0	71,391.0	65,628.0	41,125.0	51,490.0	61,203.0	8.0	67,979.0	49,297.0	47,573.0	46,953.0
May 25-28	1.50	3,050.0	6,566.5	6,611.0	5,326.0	4,988.0	4,401.0	5,532.0	0	5,641.0	4,313.0	7,260.0	5,675.0
July 1-2-3-4	2.26	0	0	202.0	0	0	80.0	104.0	0	190.0	0	768.0	135.0
July 22	1.81	1,774.0	7,058.0	4,657.0	4,640.0	841.0	6,691.0	885.0	0	4,826.0	13,041.0	19,893.0	19,016.0
Sept. 15	1.47	1,058.0	2,095.0	4,966.0	4,154.0	412.0	4,618.0	1,233.0	0	4,642.0	13,918.0	9,458.0	12,228.0
Sept. 26	.80	426.0	582.0	1,458.0	1,290.0	90.0	841.0	412.0	0	1,523.0	3,910.0	2,851.0	3,146.0
Oct. 6-7	2.58	4,750.0	8,178.5	10,301.0	9,936.0	990.0	8,397.0	2,698.0	9.0	10,542.0	35,868.0	33,263.0	29,962.0
Oct. 22-23-24-25	2.55	538.0	1,593.0	1,824.0	974.0	123.0	379.0	495.0	0	1,246.0	283.0	6,693.0	4,959.0
Nov. 2-3	1.05	0	0	0	0	0	0	0	0	312.0	0	598.0	771.0
Dec. 5-6	3.14	1,528.0	1,885.5	3,638.0	3,994.0	834.0	1,787.0	1,433.0	0	5,088.0	10,242.0	8,934.0	8,745.0
Dec. 27	.94	0	0	0	0	0	0	0	0	0	0	273.0	219.0
Dec. 30	.37	0	205.5	311.0	226.0	82.0	73.0	103.0	0	382.0	1,911.0	843.0	1,214.0
1937													
Jan. 1	.90	204.0	432.5	1,076.0	749.0	315.0	581.0	296.0	0	1,454.0	4,669.0	2,421.0	4,096.0
Jan. 11-12	1.67	0	0	0	0	0	0	0	0	0	181.0	320.0	313.0
Jan. 14	.33	0	0	0	0	0	0	0	0	0	187.0	373.0	113.0
Jan. 19-20-21-22-24	2.91	462.0	321.0	806.0	892.0	158.0	284.0	230.0	0	1,311.0	4,695.0	3,668.0	3,299.0
Feb. 20	.14	0	0	0	0	0	0	0	0	0	390.0	492.0	202.0
Mar. 6	1.03	0	0	0	0	0	0	0	0	0	1,436.0	863.0	766.0
Mar. 14	.85	0	0	0	0	0	0	0	0	0	558.0	246.0	431.0
Apr. 3-4	1.04	202.0	241.0	735.0	551.0	0	130.0	90.0	0	619.0	3,760.0	2,756.0	1,709.0
Apr. 7	.14	0	0	0	0	0	0	0	0	0	226.0	179.0	0
June 6	1.78	2,510.0	2,063.5	2,506.0	2,258.0	4,234.0	2,781.0	2,862.0	0	2,322.0	7,537.0	5,396.0	4,032.0
June 7	.33	686.0	506.0	589.0	436.0	900.0	769.0	595.0	0	465.0	2,357.0	2,412.0	2,014.0
July 10	.66	324.0	148.5	272.0	187.0	104.0	0	0	0	204.0	579.0	249.0	450.0
July 20	.67	0	0	0	0	0	0	0	0	171.0	608.0	198.0	246.0
Aug. 22	1.43	1,508.0	1,095.5	1,010.0	1,260.0	1,575.0	544.0	209.0	0	1,507.0	11,505.0	7,018.0	7,706.0
Aug. 30	.91	376.0	254.5	193.0	225.0	476.0	0	0	0	629.0	6,073.0	2,803.0	3,053.0
Sept. 2	.61	412.0	304.0	234.0	261.0	522.0	97.0	0	0	617.0	5,185.0	4,703.0	3,500.0
Oct. 17	1.03	156.0	64.5	106.0	0	0	0	0	0	180.0	0	896.0	462.0
Nov. 8-9-10	2.90	342.0	268.0	205.0	322.0	281.0	386.0	337.0	0	733.0	2,047.0	7,032.0	400.0
Nov. 15	1.61	2,596.0	3,720.0	2,237.0	4,561.0	4,215.0	8,823.0	7,913.0	2.3	5,342.0	21,468.0	24,188.0	9,049.0
Dec. 16	2.60	988.0	3,657.5	1,954.0	2,038.0	2,341.0	3,249.0	2,987.0	0	1,630.0	6,084.0	6,709.0	2,982.0
Dec. 22-28	3.24	90.0	322.0	376.0	621.0	396.0	972.0	930.0	0	662.0	2,972.0	4,417.0	3,146.0
1938													
Jan. 23	3.93	3,730.0	22,363.0	12,312.0	18,450.0	6,970.0	11,678.0	11,550.0	12.0	12,266.0	24,428.0	36,191.0	27,872.0
Feb. 17-18	1.29	0	0	0	0	0	0	0	0	0	512.0	416.0	244.0
Mar. 18	1.01	874.0	1,832.0	1,842.0	1,438.0	172.0	325.0	265.0	0	736.0	3,605.0	4,700.0	3,503.0
Mar. 27	2.00	476.0	1,340.0	1,247.0	646.0	0	67.0	65.0	0	305.0	5,494.0	7,702.0	6,208.0
Mar. 28	.80	2,050.0	9,995.0	5,908.0	11,302.0	235.0	505.0	642.0	0	6,228.0	14,554.0	15,312.0	15,011.0
Apr. 5	.27	0	55.0	81.0	98.0	0	0	0	0	0	291.0	209.0	115.0
Apr. 7	1.21	750.0	1,447.5	1,379.0	1,524.0	0	65.0	71.0	0	798.0	5,340.0	5,814.0	5,649.0
Apr. 15	.69	0	33.5	131.0	60.0	0	0	0	0	0	659.0	1,108.0	1,190.0
Apr. 15 p. m.	1.57	298.0	1,021.0	932.0	1,230.0	0	0	28.0	0	641.0	5,516.0	6,122.0	6,120.0
May 13	.43	0	0	0	0	223.0	92.0	83.0	0	0	0	0	0
May 23	.49	124.0	56.0	176.0	164.0	183.0	105.0	123.0	0	143.0	0	0	0
June 1	1.73	5,168.0	10,027.0	7,070.0	9,740.0	8,545.0	7,870.0	12,603.0	9.0	4,870.0	15,856.0	11,110.0	14,113.0
June 11	.53	1,182.0	4,502.5	2,804.0	2,718.0	2,040.0	2,421.0	2,537.0	0	1,514.0	4,369.0	3,048.0	2,907.0

TABLE 30.—*Soil loss in runoff from control plots by individual rains, 1931–40*—Continued

[8.75-percent slope, Kirvin fine sandy loam]

Date of rains producing runoff	Amount of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre	Soil loss in runoff per acre
1938–Cont.	*Inches*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
June 17	1.28	0	30.5	70.0	139.0	0	0	206.0	0	53.0	307.0	281.0	400.0
Aug. 10	.75	1,098.0	659.0	1,007.0	1,007.0	635.0	67.0	2,319.0	0	3,567.0	3,195.0	2,008.0	1,730.0
Aug. 12	1.43	1,594.0	3,150.0	4,984.0	3,493.0	1,500.0	580.0	8,517.0	0	7,194.0	17,377.0	15,083.0	16,247.0
Sept. 14	.42	0	65.5	123.0	113.0	0	0	510.0	0	790.0	1,266.0	586.0	492.0
Nov. 3	2.28	578.0	2,249.0	2,006.0	1,359.0	398.0	115.0	2,299.0	0	5,603.0	7,500.0	8,000.0	7,094.0
Nov. 6	1.86	800.0	4,395.5	2,902.0	2,724.0	450.0	235.0	4,004.0	0	6,139.0	7,290.0	8,191.0	5,994.0
Dec. 22-23-25-26	2.88	164.0	680.0	822.0	542.0	0	0	107.0	0	1,085.0	146.0	3,249.0	2,600.0
1939													
Jan. 8–9	2.09	126.0	63.5	245.0	156.0	55.0	0	135.0	0	85.0	452.0	2,396.0	2,277.0
Jan. 11–12	1.87	0	30.5	125.0	75.0	0	0	0	0	0	417.0	985.0	944.0
Feb. 1-2-3	1.87	704.0	2,037.0	3,206.0	1,868.0	1,060.0	440.0	1,965.0	0	1,669.0	3,942.0	7,229.0	6,453.0
Feb. 14	.81	378.0	263.0	459.0	514.0	562.0	294.0	444.0	0	524.0	1,819.0	3,031.0	2,180.0
Feb. 17–18–19	2.82	834.0	4,485.5	3,769.0	3,905.0	3,675.0	1,446.0	4,551.0	0	5,241.0	8,970.0	9,860.0	8,939.0
Feb. 24, 25 and 27	2.00	464.0	1,287.5	1,511.0	1,348.0	1,362.0	553.0	1,467.0	0	848.0	4,702.0	4,996.0	5,675.0
Mar. 25	.76	0	0	0	0	0	0	0	0	0	505.0	380.0	441.0
Mar. 28 a. m.	.34	642.0	1,212.5	1,617.0	1,240.0	933.0	371.0	799.0	0	1,538.0	2,734.0	3,359.0	3,052.0
Mar. 28 p. m.	.31	0	189.5	177.0	181.0	138.0	59.0	229.0	0	298.0	1,627.0	1,105.0	1,342.0
Apr. 5	.52	70.0	309.0	382.0	269.0	336.0	79.0	185.0	0	461.0	1,184.0	879.0	1,188.0
Apr. 10	.60	0	208.5	325.0	278.0	212.0	0	100.0	0	490.0	1,218.0	897.0	1,005.0
Apr. 16	.65	284.0	355.5	451.0	399.0	145.0	84.0	152.0	0	740.0	1,535.0	1,462.0	2,105.0
May 18	.65	1,172.0	673.0	1,374.0	1,380.0	990.0	1,285.0	1,853.0	0	921.0	2,194.0	1,257.0	1,328.0
May 20	.78	1,736.0	1,361.5	2,090.0	2,311.0	1,718.0	2,150.0	2,663.0	0	1,379.0	7,274.0	4,098.0	4,491.0
May 27	.33	258.0	88.0	120.0	159.0	476.0	272.0	241.0	0	218.0	0	0	0
June 19	.54	1,014.0	262.0	1,287.0	914.0	372.0	1,109.0	1,248.0	0	914.0	1,711.0	1,428.0	1,476.0
June 20	.33	0	0	0	0	0	0	0	0	0	1,028.0	601.0	701.0
July 2	1.06	1,420.0	549.0	[2]2,570.0	1,042.0	486.0	1,569.0	732.0	0	1,123.0	4,345.0	3,861.0	5,103.0
July 9	1.79	5,566.0	6,013.5	[2]21,524.0	5,681.0	3,197.0	9,653.0	4,403.0	0	8,178.0	29,217.0	21,435.0	25,815.0
Oct. 25	.87	550.0	587.0	1,446.0	764.0	388.0	770.0	1,079.0	0	748.5	0	1,748.0	868.0
Oct. 27	.42	294.0	406.5	787.0	433.0	0	0	0	0	378.0	0	1,552.0	1,278.0
Nov. 15–16	1.21	338.0	168.5	251.0	226.0	0	0	0	0	0	0	2,413.0	2,608.0
Nov. 17–18	1.08	1,360.0	2,284.5	3,189.0	2,409.0	2,215.0	4,451.0	3,016.0	0	1,978.0	1,523.0	6,758.0	5,444.0
Dec. 22–25–26	2.62	408.0	225.0	745.0	229.0	451.0	874.0	680.0	0	453.0	661.0	3,261.0	2,976.0
1940													
Feb. 5–6	1.07	276.0	95.5	574.0	191.0	475.0	487.0	297.0	0	167.0	1,016.0	810.0	588.0
Feb. 8–9	.71	0	0	0	0	0	0	0	0	0	540.0	233.0	372.0
Feb. 16–17	.90	0	0	0	0	142.0	208.0	156.0	0	0	0	0	0

Mar. 11	.66	782.0	656.5	2,098.0	527.0	263.0	646.0	485.0	0	308.0	3,218.0	3,009.0	2,867.0
Mar. 12	.43	542.0	695.5	1,262.0	427.0	240.0	545.0	415.0	0	324.0	3,166.0	3,407.0	2,444.0
Mar. 29	.84	270.0	718.5	1,147.0	380.0	74.0	188.0	148.0	0	334.0	3,383.0	2,518.0	2,084.0
Apr. 5–6	1.62	714.0	1,487.0	1,880.0	824.0	451.0	451.0	549.0	0	1,268.0	8,918.0	8,955.0	8,277.0
Apr. 30	.52	486.0	96.0	505.0	620.0	272.0	384.0	439.0	0	384.0	292.0	308.0	725.0
May 8–9	1.14	132.0	23.5	132.0	110.0	83.0	130.0	158.0	0	0	858.0	367.0	482.0
May 17–18	1.40	1,326.0	1,044.0	1,961.0	3,850.0	2,598.0	1,787.0	1,214.0	0	1,775.0	4,210.0	3,768.0	3,594.0
May 26–27–28	1.33	1,198.0	1,145.5	1,938.0	3,777.0	1,817.0	1,434.0	1,158.0	0	2,738.0	4,111.0	3,645.0	3,570.0
June 15	2.00	2,398.0	3,473.0	4,405.0	11,027.0	4,556.0	663.0	675.0	0	3,681.0	17,151.0	11,385.0	10,962.0
June 28–29–30, July 1–2	5.38	6,032.0	22,317.5	17,667.0	21,566.0	11,819.0	1,103.0	1,158.0	0	16,401.0	43,586.0	34,083.0	30,779.0
July 13	1.57	354.0	208.0	351.0	423.0	152.0	0	0	0	895.0	11,865.0	6,316.0	6,966.0
Aug. 27–28	3.81	1,448.0	2,509.0	2,126.0	[illegible]	849.0	149.0	185.0	0	7,233.0	33,117.0	25,440.0	21,079.0
Aug. 28	.70	322.0	471.5	413.0	466.0	255.0	0	0	0	2,040.0	6,310.0	6,075.0	5,421.0
Sept. 21–22–23	3.22	232.0	349.0	253.0	289.0	0	0	0	0	2,151.0	54.0	8,165.0	7,559.0
Oct. 31	4.54	420.0	1,443.5	1,205.0	1,076.0	7,913.0	3,397.0	2,705.0	0	5,289.0	17,272.0	23,298.0	17,321.0
Nov. 9–10	2.13	104.0	197.0	206.0	219.0	2,006.0	1,007.0	499.0	0	1,764.0	3,526.0	4,581.0	3,755.0
Nov. 22–23–24–25	6.07	62.0	1,051.0	577.0	686.0	2,649.0	1,767.0	692.0	0	410.0	7,588.0	9,883.0	8,749.0
Dec. 11–12	.90	32.0	35.0	39.0	118.0	161.0	128.0	67.0	0	167.0	1,028.0	871.0	543.0
Dec. 15	1.25	0	0	0	0	0	0	0	0	0	629.0	771.0	568.0
Dec. 25–26–27	2.64	80.0	67.0	102.0	121.0	554.0	453.0	160.0	0	251.0	1,962.0	2,299.0	1,037.0

[1] Record of soil loss for rain of Mar. 3 was lost.
[2] Plot not level, causing concentration on west side of plot and forming gully.

TABLE 31.—*Surface runoff from control plots by individual rains, 1931–40*

[8.75 percent slope, Kirvin fine sandy loam]

Date of rains producing runoff	Amount of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall
1931	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Apr. 20	0.98	2.14	0.71	1.02	1.73	1.02	3.67	12.24	1.84	12.65	1.12	1.12	1.02
Apr. 29	1.22	0	0	0	0	0	0	1.48	0	5.16	0	0	0
May 3	.30	22.00	22.33	29.33	22.00	20.67	18.33	22.00	2.33	18.33	2.33	1.33	1.33
May 19	.54	0	0	0	0	0	0	0	.74	10.19	0	0	0
June 13	1.69	27.51	27.69	21.12	26.04	25.74	27.93	21.72	5.44	27.51	29.29	21.66	21.54
June 16-17	2.40	38.46	38.17	36.42	42.17	40.79	41.79	33.17	24.50	35.00	36.92	42.08	42.63
July 29-30-31	1.14	1.32	1.75	3.16	1.58	1.23	27.19	.35	.35	17.54	26.48	17.19	23.16
Aug. 19	1.84	16.74	22.99	23.32	20.54	19.73	37.61	.22	.22	23.64	34.24	33.48	37.34
Aug. 21	.35	25.14	25.14	30.29	26.29	25.14	36.29	.57	1.14	26.29	24.29	24.29	28.29
Aug. 29	.53	9.81	14.53	13.96	10.38	12.45	28.30	0	0	12.45	16.79	13.40	20.00
Oct. 15	.45	34.44	33.78	31.78	33.33	38.89	51.56	4.89	1.56	37.11	37.33	33.33	44.67
Oct. 23	1.46	5.55	8.22	7.05	4.32	.48	.48	.75	.48	7.81	1.78	13.97	17.67
Oct. 28	.40	3.75	2.25	2.75	1.75	.50	.50	1.00	.50	5.50	3.75	16.00	23.25
Nov. 17	.35	2.00	.29	.57	1.14	.29	2.00	1.14	1.14	6.29	2.00	7.43	14.29
Nov. 19	.90	49.11	61.11	58.89	59.11	42.56	58.44	43.67	.44	48.56	45.33	63.67	67.78
Nov. 26	.67	.60	11.04	1.64	1.04	0	.60	.30	.30	4.93	2.69	5.37	7.01
Nov. 28-29	1.30	9.62	12.15	12.15	11.92	6.54	11.92	5.92	.15	13.00	22.92	22.92	22.38
Dec. 1	1.10	9.36	12.55	11.36	11.09	4.36	11.73	4.36	.36	13.36	39.00	32.45	28.55
Dec. 12	.52	43.85	51.15	47.31	47.50	45.77	61.35	45.77	1.35	52.69	65.58	64.81	63.46
Dec. 16-17	2.07	14.59	23.24	22.08	23.86	19.37	33.96	16.71	.34	26.14	48.02	35.75	34.06
Dec. 18	.50	0	0	0	0	0	0	0	0	4.40	16.20	14.00	13.20
Dec. 19	.52	2.88	5.96	7.12	5.58	4.23	18.46	2.88	.77	15.58	41.15	38.65	42.12
Dec. 23	.23	19.13	25.65	27.39	27.39	25.65	41.74	23.91	0	38.26	53.48	51.74	53.04
Dec. 30	1.03	67.18	71.84	71.55	72.62	75.44	81.17	73.69	8.93	70.78	59.51	41.84	62.62
1932													
Jan. 4	5.67	48.1	57.2	85.9	93.7	74.8	65.5	48.8	11.0	51.9	71.7	60.0	48.7
Jan. 11	2.02	25.1	27.1	22.7	28.6	30.9	41.8	30.8	.4	38.7	45.5	40.6	29.2
Jan. 15	.54	1.3	5.4	2.7	1.3	0	9.5	4.7	.6	12.9	32.6	23.8	26.5
Jan. 17	.32	11.5	14.9	8.0	6.9	0	21.8	12.6		24.2	51.7	40.2	46.0
Jan. 25	.83	.9	1.3	.4	.2	0	5.3	1.8	.2	7.1	17.7	11.6	10.6
Feb. 13-15	1.11	0	0	0	0	0	1.6	1.0	.6	3.6	6.6	3.0	4.3
Feb. 16	.47	7.8	15.6	18.7	14.7	19.5	31.2	20.3		18.0	38.3	19.5	30.4
Feb. 18-19	1.93	1.9	6.6	8.6	6.1	7.4	23.4	8.8	.2	10.8	40.0	33.2	33.0
Feb. 20	.86	12.0	18.4	17.1	13.7	13.7	20.5	17.5	.2	18.8	45.0	35.9	35.9
Mar. 3	1.45	8.1	12.7	11.7	9.4	9.4	4.0	11.5	.3	13.0	30.6	24.6	24.6
Mar. 4	1.42	6.7	15.8	15.6	11.9	8.8	13.2	7.5	1.3	22.0	37.0	32.0	35.4

Apr. 22-23	.72	2.04	.5	1.02	1.02	5.10	11.72	.51	.51	3.06	1.02	1.02	.51
Apr. 28-29	1.94	4.9	2.2	2.5	4.2	6.4	3.2	.9	.2	4.0	.9	.8	.6
May 8	.49	.8	.2	.4	.4	.4	15.0	.7	.7	5.2	.4	.4	.8
May 15	1.04	6.4	5.9	4.6	4.6	6.7	28.4	4.3	.2	12.1	.7	.7	.7
June 25	1.19	12.3	12.5	11.4	12.0	10.5	33.7	13.0	0	15.4	.3	.3	1.5
July 6	.96	9.9	9.4	9.2	8.0	36.0	43.7	6.1	0	28.4	6.9	5.7	3.1
July 11	.35	0	.5	1.0	1.0	6.3	12.7	0	0	5.3	1.0	2.1	3.2
July 22	1.47	40.0	44.7	43.3	43.7	50.5	59.0	37.8	1.2	44.5	49.8	45.5	49.8
Aug. 18	.28	15.8	23.0	17.1	14.5	25.0	27.6	11.9	0	10.5	5.2	5.2	18.4
Sept. 4	2.30	.3	1.1	.6	.2	.6	.2	.3	0	1.4	18.8	8.3	27.4
Oct. 4	.72	21.4	25.7	18.3	18.3	24.0	17.8	21.4	.	21.4	41.3	27.5	41.8
Oct. 25	.91	7.2	11.7	7.3	4.8	0	0	0	0	7.3	0	14.5	19.3
Nov. 23	.63	14.0	17.5	12.9	12.9	9.0	12.3	4.1	.6	15.	3.5	22.8	31.6
Dec. 9	.44	3.3	6.2	4.2	4.2	5.0	7.5	.8	0	4.2	.8	.8	7.5
Dec. 14-15	.45	0	0	0	0	0	0	0	0	.8	.8	1.6	6.6
Dec. 15-16	.98	.8	.3	.8	.8	.8	.8	.8	1.1	1.9	2.7	5.7	5.7
Dec. 23	3.38	49.1	45.7	51.2	49.2	48.1	48.3	44.8	1.2	51.3	60.7	58.9	62.4
Dec. 29-30	4.91	47.7	50.4	50.4	46.6	44.4	45.3	40.2	2.3	47.0	79.8	53.0	53.0
1933													
Jan. 7-8-9	2.55	1.4	13.9	2.4	1.9	.9	.6	.4	.3	1.7	41.7	7.6	6.3
Jan. 21-22	1.18	25.6	27.6	32.2	28.8	32.5	30.3	28.1	0	26.9	35.5	22.8	20.9
Jan. 31	.75	19.6	24.6	29.4	20.0	23.5	19.1	15.7	0	15.2	26.5	9.8	14.7
Feb. 7	.42	24.6	24.3	33.3	25.4	33.3	31.6	24.6	.4	20.2	28.9	14.1	14.1
Mar. 18	.85	12.0	19.2	14.3	10.9	13.5	13.5	4.8	.2	7.4	8.7	5.6	5.6
Mar. 24	1.01	29.2	36.7	33.1	33.4	34.2	38.2	30.9	.7	33.1	40.0	32.8	32.8
Mar. 30-31	1.71	50.5	48.0	50.5	49.0	45.2	57.6	47.4	2.6	47.4	56.0	48.2	51.2
Apr. 13-14	.90	3.3	.4	1.2	1.6	9.0	1.2	2.9	0	4.5	0	.4	.4
Apr. 20	.40	7.4	1.4	5.5	7.3	20.2	8.2	12.0	0	1.8	0	.4	1.8
Apr. 25-26	2.09	34.8	21.8	28.9	26.2	44.2	34.5	37.2	1.2	27.2	21.8	20.4	25.9
Apr. 29	.69	23.4	17.3	23.4	21.3	37.2	22.3	26.1	0	18.6	11.7	9.1	17.0
May 4	1.00	10.3	9.9	10.7	12.9	34.2	2.6	6.2	.4	10.5	.7	.7	1.1
May 21	.63	39.4	32.5	28.0	31.0	40.1	29.8	25.8	.3	8.8	12.3	9.9	10.5
May 24-25	2.30	33.2	33.4	33.6	33.9	39.2	33.8	29.6	.5	26.9	36.8	32.5	36.0
July 15	.78	0	3.6	1.9	1.4	5.2	1.4	0	0	7.2	0	0	.5
July 19	2.83	9.1	8.1	10.1	10.6	21.6	6.4	19.2	.3	21.2	21.6	23.5	24.2
Aug. 6-7	.59	2.5	6.2	2.5	0	0	5.5	5.5	0	.6	1.2	1.2	3.1
Aug. 12-13	1.55	22.3	30.7	24.7	16.6	.7	29.4	28.7	.2	9.5	27.5	22.6	26.4
Aug. 17	.56	1.3	.3	.6	0	0	0	15.8	0	3.9	1.3	1.3	1.3
Aug. 25	1.07	11.7	19.9	16.5	6.5	.3	8.2	20.6	.3	9.6	28.2	18.9	30.2
Sept. 9-10-11-12	3.27	34.8	41.5	40.7	30.6	5.6	36.4	47.0	.2	33.0	49.1	44.6	49.5
Sept. 27	.60	2.5	10.4	8.6	.6	0	8.0	.6	0	3.7	15.3	10.4	15.3
Oct. 12	.78	1.0	3.3	3.3	.9	0	3.3	1.4	0	1.4	9.4	6.1	9.4
Oct. 13	.22	0	0	0	0	0	0	0	0	0	6.7	3.3	6.7
Nov. 3	.89	0	0	0	0	0	0	0	0	0	0	7.9	12.4
Dec. 2	1.36	23.8	26.2	26.8	15.1	11.6	8.4	26.8	.5	26.8	5.4	40.8	42.5
Dec. 15-16	3.94	38.2	49.2	49.9	37.2	24.8	31.6	31.9	.5	34.2	42.9	55.8	58.3
Dec. 28-29-30	2.44	4.8	11.2	11.5	7.3	1.8	5.7	3.6	0	5.4	7.3	22.5	23.1
1934													
Jan. 3	1.40	18.9	31.0	28.5	23.7	13.4	21.8	14.5	.3	18.4	30.5	44.2	44.7
Feb. 8	1.12	0	0	0	0	0	0	0	0	0	2.6	3.3	2.3
Feb. 18	1.01	11.6	15.4	20.7	12.4	6.2	17.8	13.1	.7	9.1	20.0	26.9	26.9

TABLE 31.—*Surface runoff from control plots by individual rains, 1931–40*—Continued

[8.75 percent slope, Kirvin fine sandy loam]

Date of rains producing runoff	Amount of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall
1934	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Feb. 25	0.36	14.3	10.7	16.3	12.3	12.3	17.4	18.4	0	13.3	16.3	14.3	15.3
Feb. 28, Mar. 1, 2, 3, 4	3.61	9.8	12.9	14.3	10.9	4.8	11.6	12.0	.2	8.6	38.1	28.2	30.0
Mar. 24, 25	3.94	10.2	13.7	12.9	10.6	9.2	2.9	7.3	1.3	7.3	33.0	32.2	35.3
Apr. 5	4.15	23.1	20.0	17.1	13.3	19.6	26.6	28.1	1.1	19.9	34.7	38.1	36.5
Apr. 16	.75	9.8	11.0	7.8	9.8	8.8	10.3	12.3	.5	2.0	3.4	3.4	2.5
Apr. 24	1.56	57.0	56.9	53.3	59.0	57.7	47.7	62.0	7.3	43.1	52.8	49.8	51.9
June 12	.97	15.2	14.4	16.7	17.4	15.5	11.4	13.6	0	13.6	10.6	9.8	7.9
Aug. 14	.62	34.5	35.1	34.5	34.5	32.7	33.3	22.6	.5	28.5	11.9	20.2	18.4
Sept. 14	.94	28.71	28.76	27.00	28.12	2.34	3.86	.78	0	21.40	10.75	27.35	25.25
Nov. 2	.62	2.4	3.0	2.4	2.4	1.2	3.6	2.4	0	.6	1.2	1.8	3.6
Nov. 19	1.92	52.5	47.8	45.5	51.3	48.8	51.8	53.0	.2	38.1	53.7	57.6	58.7
Nov. 20, 21	1.72	7.3	9.5	9.2	7.7	4.5	6.6	5.3	0	3.6	37.6	34.0	37.2
Nov. 29	1.32	20.6	27.6	22.8	21.6	20.0	25.2	21.4	.3	8.9	55.3	49.2	50.0
Dec. 2	1.81	51.2	49.0	53.2	51.2	49.6	53.4	52.0	.4	44.1	68.1	64.7	66.5
1935													
Jan. 7	.90	1.6	1.0	2.4	2.0	1.2	1.6	2.9	.2	1.2	15.5	17.5	14.3
Jan. 19–20	2.58	28.8	20.2	34.8	31.0	28.2	27.0	30.1	.4	21.5	39.0	40.3	40.5
Feb. 8	2.04	19.8	15.3	22.7	19.3	16.2	12.8	12.1	.9	9.6	35.5	33.0	29.8
Feb. 12	.77	0	0	0	0	0	0	0	0	0	1.1	1.1	1.0
Mar. 4	1.40	23.6	22.9	25.2	23.1	4.2	4.0	25.2	.5	1.0	48.7	38.4	39.2
Mar. 6	.48	9.1	13.4	19.0	16.0	11.4	8.4	15.2	0	0	33.6	26.0	26.0
Apr. 20	.77	5.7	2.4	4.8	.5	12.4	1.9	6.2	.05	12.4	2.9	.9	.5
Apr. 25–26	2.47	22.3	20.1	22.4	19.8	28.3	27.6	23.9	.4	24.2	14.0	9.8	8.0
Apr. 28	.52	47.9	51.9	49.6	45.3	53.5	53.1	45.3	.7	41.8	27.0	21.3	20.6
May 2–5	5.52	42.7	38.7	43.5	41.5	44.5	47.4	41.8	1.3	38.4	54.6	47.7	48.8
May 15	1.18	27.5	17.5	24.1	13.8	22.8	29.7	24.7	1.6	12.5	16.3	12.5	6.2
May 18–19	1.59	13.0	11.3	13.6	8.5	9.5	10.6	8.1	.2	5.8	25.0	21.0	16.9
June 17	1.21	18.8	8.2	10.0	5.8	14.9	13.7	14.6	.6	17.9	18.5	12.2	9.1
June 21	.42	17.5	10.5	13.2	5.3	14.9	15.8	14.9	.9	18.4	11.4	5.3	6.1
July 2	.51	0	0	0	0	9.4	5.8	0	0	0	0	0	0
July 3	1.23	34.8	31.2	35.9	32.3	56.3	54.8	38.0	2.4	32.6	49.4	44.6	40.1
July 21	.50	8.8	4.8	8.8	3.7	16.9	7.3	7.3	1.5	9.6	2.2	3.7	2.9
Aug. 14	1.02	10.1	4.3	5.8	.7	38.5	27.0	9.7	.3	12.9	21.9	15.8	.7
Sept. 8	1.01	0	0	0	0	2.9	0	0	0	0	4.7	.7	0
Sept. 9	.37	2.0	4.0	5.0	1.0	22.8	8.0	4.0	0	9.9	29.7	19.8	1.0
Sept. 24–26	1.69	13.5	13.3	16.1	.7	22.4	11.5	13.9	0	19.3	38.0	25.0	1.1

Oct. 18	.38	0	0	0	0	0	0	0	0	1.0	9.7	4.8	2.0
Oct. 22-23	1.95	1.9	1.1	1.7	.4	2.3	.9	.6	.2	5.3	2.4	14.3	1.1
Oct. 27	3.34	48.7	47.8	53.1	17.4	49.7	51.6	47.2	.3	53.8	66.5	65.0	56.7
Nov. 1	.28	2.6	1.3	2.6	0	7.8	10.4	3.9	0	7.8	25.0	27.6	21.0
Nov. 4	.52	7.0	6.7	8.5	1.4	20.6	21.3	12.0	.7	18.4	36.9	35.5	31.9
* Nov. 9-10-11	2.76	44.3	42.9	48.1	23.2	52.7	55.5	50.5	.4	59.4	62.3	56.3	58.4
Nov. 26	.99	11.8	10.8	14.5	4.1	20.0	20.4	16.0	.4	20.4	27.5	21.2	20.0
Dec. 5-6	3.66	26.3	53.5	46.5	19.4	44.5	50.5	42.0	0	42.2	75.6	49.4	55.9
1936													
Mar. 24	.73	26.30	16.58	22.19	11.10	24.66	33.84	30.82	16.58	34.25	39.32	34.25	28.77
Apr. 28	3.00	20.13	19.83	21.23	21.50	16.20	22.60	22.10	.37	19.17	17.43	6.73	9.20
May 8-9-10	5.06	38.42	34.98	42.87	40.61	37.92	35.73	37.63	3.56	33.77	40.32	44.62	42.87
May 25-28	1.50	26.07	23.67	28.00	27.27	29.93	29.73	29.93	0	23.80	23.07	23.33	26.00
July 1-2-3-4	2.26	.66	0	2.12	.16	.31	1.77	.80	0	1.81	0	1.46	1.46
July 22	1.81	24.42	19.61	26.46	25.64	16.69	25.86	19.34	.61	26.85	30.72	41.10	40.11
Sept. 15	1.47	44.63	37.55	42.59	46.12	28.30	47.82	45.10	0	44.08	42.11	40.61	44.35
Sept. 26	.80	24.00	21.13	23.00	25.38	6.50	25.25	25.25	0	24.88	20.25	17.00	22.50
Oct. 6-7	2.58	46.82	47.60	52.25	51.24	35.27	54.53	52.25	2.02	52.25	54.22	53.53	54.53
Oct. 22-23-24-25	2.55	8.67	9.10	10.12	8.24	1.14	2.75	2.90	.15	12.71	1.45	15.61	11.10
Nov. 2-3	1.05	8.38	5.81	8.38	6.29	2.76	4.19	3.52	.35	12.95	5.24	18.57	21.71
Dec. 5-6	3.14	34.49	37.99	42.23	38.92	30.96	35.19	40.35	.70	44.81	40.35	57.01	56.75
Dec. 27	.94	4.68	2.98	6.28	4.68	.74	.74	6.28	0	7.02	3.94	7.87	9.36
Dec. 30	.37	31.89	30.81	31.89	31.89	22.97	26.76	31.89	0	35.95	41.89	46.76	44.86
1937													
Jan. 1	.90	41.78	45.78	45.44	45.00	42.11	46.67	45.78	.44	49.11	46.67	53.56	55.44
Jan. 8-9-10-11-12	1.67	10.60	13.35	14.55	12.10	8.14	10.78	10.60	.42	14.79	9.94	17.60	16.95
Jan. 14	.33	6.67	6.06	3.33	10.00	2.12	3.33	4.55	1.21	6.67	15.76	27.88	25.76
Jan. 19-20-21-22-24	2.91	27.35	32.27	31.75	33.16	25.70	17.46	29.11	.38	31.27	37.84	44.67	45.19
Feb. 19	.75	0	0	0	0	0	0	0	0	0	4.93	7.33	6.93
Feb. 20	.14	0	2.86	5.00	0	0	0	0	0	0	45.00	52.86	47.14
Feb. 26	.72	0	0	0	2.08	0	0	0	0	0	.97	5.14	2.50
Mar. 6	1.03	12.91	16.99	21.46	16.41	1.75	6.41	7.86	.68	14.27	28.54	31.46	33.59
Mar. 14	.85	11.29	18.82	19.88	14.24	2.12	6.94	10.35	.47	16.00	28.12	32.47	29.06
Apr. 3-4	1.04	23.37	26.54	27.21	25.10	8.46	14.90	21.25	1.06	30.77	32.60	33.27	34.33
Apr. 7	.14	15.71	7.86	20.71	18.57	2.86	2.86	7.86	0	18.57	12.86	12.86	7.86
Apr. 20	1.01	2.18	.40	.69	1.09	1.09	1.09	1.09	15.64	1.49	1.78	1.78	1.78
June 6	1.78	29.38	24.61	29.78	30.39	30.22	32.47	33.31	.62	28.15	31.24	25.67	25.45
June 7	.33	40.30	34.55	41.21	39.09	34.55	33.33	34.55	1.21	37.88	62.42	59.09	59.09
July 7	1.00	0	.20	.40	.40	.40	.40	.40	0	.40	1.10	1.10	1.50
July 10	.66	14.55	11.97	14.55	15.00	8.33	5.00	1.67	0	12.27	20.61	16.67	19.55
July 20	.67	0	0	0	0	0	0	0	0	2.69	8.21	6.57	6.57
Aug. 22	1.43	33.50	32.59	29.86	30.35	30.91	26.01	10.56	.28	31.19	38.39	37.83	39.65
Aug. 30	91	23.52	23.52	20.99	20.22	17.80	8.90	1.98	0	22.20	29.89	21.87	21.43
Sept. 2	.61	36.23	36.89	36.23	33.11	27.21	14.43	4.75	0	33.11	38.69	38.03	33.11
Oct. 17	1.03	6.41	4.85	5.34	0	0	0	0	0	12.14	.58	8.93	11.46
Nov. 8-9-10	2.90	15.24	20.83	16.00	3.17	5.59	11.93	10.55	.14	28.21	15.76	34.66	6.21
Nov. 15	1.61	63.17	41.74	67.95	58.32	60.87	67.02	64.97	2.48	69.07	65.22	69.75	54.22
Dec. 16	2.60	8.50	11.04	14.00	12.62	13.88	14.46	13.88	.58	12.46	15.58	17.15	9.08
Dec. 22-28	3.24	17.07	13.09	11.94	10.22	13.06	15.12	16.70	.12	10.80	32.50	26.94	25.93

TABLE 31.—*Surface runoff from control plots by individual rains, 1931–40*—Continued

[8.75 percent slope, Kirvin fine sandy loam]

Date of rains producing runoff	Amounts of rainfall	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12
		Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall	Surface runoff in percent of rainfall
1938	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Jan. 23	3.93	65.04	58.24	60.36	56.31	56.31	55.67	57.91	3.94	53.79	58.31	52.01	55.57
Feb. 17–18	1.29	2.95	.47	.93	.78	.31	.54	.54	0	.54	8.29	7.13	5.74
Mar. 18	1.01	24.55	14.06	19.21	18.12	11.98	18.91	20.00	0	16.44	21.09	22.97	20.40
Mar. 27	2.00	19.10	11.65	16.20	12.00	2.60	10.10	11.05	.35	13.60	29.30	34.60	29.45
Mar. 28	.80	69.25	61.63	67.50	69.50	57.13	68.63	70.38	12.00	67.63	80.13	79.63	75.50
Apr. 5	.27	12.96	8.89	15.19	13.33	0	5.56	4.07	0	10.74	8.15	8.15	4.07
Apr 7	1.21	23.64	18.60	23.22	22.48	3.97	13.97	13.72	1.24	19.75	31.07	28.02	21.02
Apr 15	.69	11.30	7.83	12.90	8.41	0	.58	1.59	0	8.55	15.51	14.35	13.91
Apr. 15 p. m.	1.57	28.60	25.03	32.23	30.89	.70	10.57	11.02	.45	26.75	42.93	44.33	43.18
May 13	.43	0	0	0	0	9.30	6.05	6.05	0	3.49	0	0	0
May 23	.49	7.55	2.86	6.94	5.71	8.98	11.22	9.80	0	10.61	2.24	1.43	1.43
June 1	1.73	31.91	31.62	32.89	34.80	31.50	31.73	35.14	1.68	27.86	45.14	42.60	47.46
June 11	.53	41.70	41.32	41.32	40.57	37.55	38.87	38.11	0	37.55	36.70	25.00	27.17
June 17	1.28	3.13	1.17	4.14	4.06	1.17	.86	5.78	0	2.58	8.05	5.16	8.05
Aug. 10	.75	27.73	20.00	25.87	26.40	18.13	4.93	35.87	4.93	30.93	19.20	22.53	23.07
Aug. 12	1.43	44.97	41.47	44.20	43.22	33.71	26.78	45.87	0	40.70	55.38	52.52	50.70
Sept. 14	.42	6.19	4.05	5.48	5.71	.95	.95	12.38	0	17.62	15.00	10.48	10.48
Nov. 3	2.28	18.60	15.30	18.38	17.46	10.18	3.25	21.14	.96	19.87	30.83	30.22	32.46
Nov. 6	1.86	24.57	22.15	24.57	23.28	15.81	7.90	24.14	.81	23.98	38.60	36.45	39.19
Dec. 22-23-25-26	2.88	10.66	12.81	14.20	7.67	.24	.24	1.67	.14	16.49	2.95	22.50	30.17
1939													
Jan. 8–9	2.09	4.68	1.53	5.41	3.73	1.05	.33	1.58	.19	1.24	7.56	20.10	19.71
Jan. 11–12	1.87	3.69	1.93	4.55	3.69	.80	.59	1.18	.21	1.18	17.70	24.60	24.81
Jan. 15	.24	0	0	0	0	0	0	0	0	0	13.75	16.67	15.42
Feb. 1-2-3	1.87	26.20	21.55	28.50	25.88	18.50	17.33	23.85	.80	19.30	25.78	30.11	31.34
Feb. 14	.81	23.58	16.17	21.60	19.75	22.59	18.15	25.80	.49	13.95	17.78	31.11	33.58
Feb. 17–18–19	2.82	31.21	24.89	31.31	28.09	25.60	22.77	25.57	.64	26.42	37.94	35.53	44.47
Feb. 24-25-27	2.00	22.20	15.15	22.60	19.95	19.95	16.35	19.00	.35	15.00	27.55	27.70	30.05
Mar. 25	.76	0	0	0	0	1.97	1.45	1.97	0	.92	5.26	5.26	4.87
Mar. 28 a. m.	.34	42.06	38.82	42.65	38.82	34.12	30.00	34.41	2.06	36.18	34.41	37.06	38.53
Mar. 28 p. m.	.31	25.16	17.10	26.77	23.55	24.84	17.74	23.55	0	18.71	22.90	25.48	27.74
Apr. 5	.52	20.58	14.62	23.65	20.00	17.50	10.58	16.92	.77	18.27	11.54	12.50	13.08
Apr. 10	.60	19.00	14.33	24.23	20.00	17.17	5.50	14.67	0	19.50	13.67	12.67	15.00
Apr. 16	.65	15.23	13.08	17.69	15.69	12.46	7.38	10.15	0	15.08	12.00	13.69	15.23
May 18	.65	43.38	31.69	40.15	38.92	43.85	42.15	48.15	.62	38.31	24.31	24.62	24.00
May 20	.78	51.67	46.54	48.08	50.51	48.72	46.67	49.87	.51	43.59	45.51	37.69	44.23

May 27	.33	14.24	10.00	12.73	12.12	9.70	12.12	10.91	1.21	15.45	3.33	2.12	2.12
June 19	.54	26.67	16.48	24.26	26.30	14.26	26.30	24.81	.74	22.22	22.59	24.07	22.04
June 20	.33	6.97	2.73	7.27	6.36	1.21	6.67	3.33	0	6.07	18.48	19.70	18.48
July 2	1.06	28.49	19.62	27.36	23.96	12.45	24.72	21.79	1.42	18.58	23.87	24.34	27.26
July 9	1.79	44.80	38.72	41.40	38.99	34.64	40.56	36.98	2.23	37.82	49.05	41.01	43.41
Oct. 9-10	.72	20.00	5.28	14.72	6.11	0	1.53	3.06	0	7.64	.97	.97	1.53
Oct. 25	.87	35.29	22.99	30.69	25.29	10.92	14.25	15.86	0	21.03	0	23.33	23.10
Oct. 27	.42	42.14	33.57	41.67	38.10	0	.95	.95	0	25.24	0	34.52	33.57
Nov. 10-11-12	1.80	5.50	2.11	3.83	2.50	.22	.22	.22	0	.83	.22	4.28	4.89
Nov. 15-16	1.21	19.50	11.90	16.78	10.74	1.24	4.88	3.97	0	7.60	.58	30.08	30.99
Nov. 17-18	1.08	40.83	34.63	39.54	36.48	34.07	34.72	35.28	1.39	37.87	18.52	54.72	53.33
Nov. 29-30	1.13	2.04	1.15	2.30	1.24	0	0	0	0	0	0	4.60	4.87
Dec. 22-25-26	2.62	16.37	10.69	16.79	7.75	14.16	16.95	17.94	0	20.08	14.01	27.18	27.75
1940													
Feb. 5-6	1.07	10.19	3.74	10.09	7.76	11.68	12.71	10.56	.37	3.74	11.87	13.64	11.96
Feb. 8-9	.71	9.86	.70	10.00	2.82	11.41	12.96	7.32	0	.57	18.45	17.04	18.03
Feb. 16-17	.90	6.44	1.11	7.22	1.89	10.67	5.67	5.33	0	.44	4.11	4.44	3.67
Mar. 11	.66	21.06	14.85	23.03	18.33	19.39	21.06	21.67	2.27	11.67	20.76	21.52	20.45
Mar. 12	.43	36.98	26.05	36.74	29.77	29.77	31.40	31.63	1.63	21.16	45.81	45.58	42.56
Mar. 29	.84	22.26	15.60	22.98	16.90	10.71	17.02	19.29	0	11.31	19.88	17.38	17.14
Apr. 5-6	1.62	36.42	28.27	38.15	29.57	27.22	31.79	37.22	.43	23.77	41.23	40.12	41.79
Apr. 28	1.69	1.72	.53	.77	1.12	.65	.65	.65	.89	.65	.65	.65	.65
Apr. 30	.52	8.85	1.92	13.27	12.12	6.92	14.04	16.92	1.35	7.69	5.58	8.46	14.62
May 8-9	1.14	7.46	1.05	5.00	3.86	2.28	6.40	5.18	0	.61	13.07	11.58	12.89
May 17-18	1.40	37.71	12.93	21.36	21.36	19.93	21.36	18.29	1.86	9.79	13.93	17.43	16.86
May 26-27-28	1.33	18.87	15.11	26.84	25.56	16.62	19.17	18.42	.53	11.80	18.80	17.52	17.22
June 15	2.00	31.05	20.30	26.35	27.05	27.75	16.15	14.10	1.45	21.40	41.50	35.20	37.30
June 28, 29, 30, July 1-2	5.38	26.15	24.18	25.07	27.55	22.81	13.51	13.59	3.22	20.80	48.48	42.16	47.55
July 13	1.57	10.64	4.78	7.58	10.06	1.85	.25	.70	1.15	11.59	34.27	30.76	29.68
Aug. 27-28	3.81	37.45	29.74	31.36	30.50	17.06	7.93	5.41	.76	35.91	54.28	47.09	50.03
Aug. 28	.70	48.43	40.57	40.43	40.29	26.71	10.00	9.00	1.57	41.57	64.14	71.00	70.57
Sept. 21-22-23	3.22	21.58	16.96	13.91	12.39	.56	.68	.68	.56	26.74	1.15	39.66	42.33
Oct. 28	.26	10.77	5.00	3.08	2.69	0	0	0	0	28.46	0	12.69	15.38
Oct. 31	4.54	39.67	37.18	34.67	33.19	29.45	28.50	28.92	.33	43.19	46.52	54.30	59.89
Nov. 9-10	2.13	27.23	20.14	19.30	18.97	24.37	26.34	31.27	.19	31.83	37.56	39.01	43.43
Nov. 22-23-24-25	6.07	10.44	41.76	20.02	24.37	25.95	26.64	22.01	.25	6.97	36.47	41.38	50.87
Dec. 6-7	.40	0	0	0	0	2.75	3.75	2.75	0	1.75	4.50	5.50	5.50
Dec. 11-12	.90	14.22	6.22	8.44	7.33	14.67	15.11	16.33	0	10.22	28.44	22.33	22.33
Dec. 15	1.25	19.36	15.76	7.52	6.40	16.16	17.36	18.24	.32	8.56	45.28	40.56	52.40
Dec. 25-26-27	2.64	13.98	17.88	8.98	10.08	18.11	19.36	18.83	.68	4.73	28.90	28.45	36.63

TABLE 32.—*Annual rainfall, runoff, soil losses, and yields from control plots, 1931–40*

[Kirvin fine sandy loam, 8.75 percent slope]

Plot No. and year	Rainfall	Surface runoff		Soil loss per acre	Crop and treatment	Yield per acre
		Depth	Percent of rainfall			
	Inches	*Inches*	*Percent*	*Tons*		
Plot 1:[1]						
1931	36.10	4.36	12.08	10.00	Continuous cotton	650 lb. seed cotton
1932	46.71	8.90	19.05	12.52	do	200 lb. seed cotton
1933	44.29	7.73	17.45	16.93	do	640 lb. seed cotton
1934	35.18	6.10	17.34	12.46	do	300 lb. seed cotton
1935	48.48	10.40	21.45	25.95	Continuous cotton, fertilized	400 lb. seed cotton
1936[1]	34.17	7.20	21.07	33.84	do	220 lb. seed cotton
1937	38.52	5.85	15.19	5.55	do	440 lb. seed cotton
1938	32.43	7.54	23.25	9.59	do	460 lb. seed cotton
1939	37.14	6.57	17.69	8.94	do	480 lb. seed cotton
1940	53.62	10.69	19.94	9.19	do	640 lb. seed cotton
Total	406.64	75.34		144.97		4,430 lb. seed cotton
Average	40.66	7.53	18.52	14.50		443 lb. seed cotton
Plot 2:[2]						
1931	36.10	4.90	13.57	22.02	Continuous cotton	425 lb. seed cotton
1932	46.71	10.20	21.84	44.60	do	200 lb. seed cotton
1933	44.29	8.76	19.78	41.48	do	375 lb. seed cotton
1934	35.18	6.42	18.25	35.83	do	200 lb. seed cotton
1935	48.48	10.52	21.70	56.65	Continuous cotton, fertilized	430 lb. seed cotton
1936[2]	34.17	6.77	19.82	61.50	do	300 lb. seed cotton
1937	38.52	5.80	15.06	6.84	do	395 lb. seed cotton
1938	32.43	6.55	20.20	32.17	do	405 lb. seed cotton
1939	37.14	4.85	13.06	11.69	do	463 lb. seed cotton
1940	53.62	10.40	19.40	19.17	do	625 lb. seed cotton
Total	406.64	75.17		331.95		3,818 lb. seed cotton
Average	40.66	7.52		33.20		381 lb. seed cotton
Plot 3:[3]						
1931	36.10	4.78	13.24	17.34	Continuous cotton	465 lb. seed cotton
1932	46.71	11.72	25.09	17.74	do	220 lb. seed cotton
1933	44.29	8.91	20.12	22.66	do	510 lb. seed cotton
1934	35.18	6.24	17.74	18.56	do	240 lb. seed cotton
1935	48.48	11.64	24.01	35.91	Continuous cotton, fertilized[4]	420 lb. seed cotton
1936	34.17	7.92	23.18	55.49	do	370 lb. seed cotton
1937	38.52	6.28	16.30	6.26	do	390 lb. seed cotton
1938	32.43	7.37	22.73	23.08	do	440 lb. seed cotton
1939	37.14	6.39	17.21	24.10	do	480 lb. seed cotton

1940	53.62	9.70	18.09	19.55	do	670 lb. seed cotton
Total	406.64	80.95		240.69		4,205 lb. seed cotton
Average	40.66	8.10	19.92	24.07		420 lb. seed cotton
Plot 4:[3]						
1931	36.10	4.90	13.57	14.57	Continuous cotton, fertilized[4]	715 lb. seed cotton
1932	46.71	11.86	25.39	19.46	do	400 lb. seed cotton
1933	44.29	7.27	16.41	16.54	do	800 lb. seed cotton
1934	35.18	5.86	16.66	21.21	do	370 lb. seed cotton
1935	48.48	7.45	15.37	28.19	Continuous cotton, fertilized, field culture	440 lb. seed cotton
1936	34.17	7.52	22.01	50.45	Continuous cotton, fertilized, smooth culture	280 lb. seed cotton
1937	38.52	5.49	14.25	7.33	do	420 lb. seed cotton
1938	32.43	6.84	21.09	28.59	do	410 lb. seed cotton
1939	37.14	5.53	14.89	13.10	do	470 lb. seed cotton
1940	53.62	9.59	17.89	24.48	do	610 lb. seed cotton
Total	406.64	72.31		223.92		4,915 lb. seed cotton
Average	40.66	7.23		22.39		491 lb. seed cotton
Plot 5:[3]						
1931	36.10	4.35	12.05	16.70	Cotton; winter cover, oats	520 lb. seed cotton
1932	46.71	11.14	23.85	18.11	Corn; winter cover, oats and vetch	12.2 bu. corn
1933	44.29	6.89	15.56	16.01	Annual lespedeza; winter cover, rye, barley, and oats	1.2 tons hay
1934	35.18	5.18	14.72	9.20	Cotton; winter cover, rye, barley, and oats	150 lb. seed cotton
1935	48.48	12.21	25.19	39.05	Corn; winter cover, oats	21.11 bushels corn
1936	34.17	5.85	17.12	25.94	Cowpeas; winter cover, vetch[5]	4.10 tons (disked down)
1937	38.52	4.82	12.51	7.87	Cotton; winter cover, vetch	465 lb. seed cotton
1938	32.43	4.90	15.11	10.80	Sorghum; winter cover, vetch	1.85 tons air dried
1939	37.14	4.55	12.25	9.44	Cowpeas; winter cover, vetch	330 lb. peas in hull
1940	53.62	8.61	16.06	18.78	Cotton; winter cover, vetch	740 lb. seed cotton
Total	406.64	68.50		171.90	Total for cotton only	1,875.0 lb. seed cotton
Average	40.66	6.85	16.85	17.19	Average, 4 years	468.8 lb. seed cotton
Plot 6:[3]						
1931	36.10	6.00	16.62	20.88	Corn; winter cover, oats	20 bu. corn
1932	46.71	12.40	26.55	11.86	Annual lespedeza; winter cover, oats, and vetch.	1.1 ton hay
1933	44.29	7.59	17.14	13.91	Cotton; winter cover, rye, barley, and oats	780 lb. seed cotton
1934	35.18	5.80	16.49	13.37	Corn; winter cover, rye, barley, and oats	8 bu. corn
1935	48.48	12.11	24.98	24.05	Annual lespedeza; winter cover, vetch	
1936	34.17	7.33	21.45	41.74	Cotton; winter cover, vetch[5]	150.0 lb. seed cotton
1937	38.52	4.97	12.90	9.41	Sorghum; winter cover, vetch	1.95 tons air-dried
1938	32.43	4.99	15.39	12.16	Cowpeas; winter cover, vetch	400.0 lb. peas in hull
1939	37.14	4.61	12.41	9.49	Cotton; winter cover, vetch	430.0 lb. seed cotton
1940	53.62	7.72	14.40	7.59	Sorghum; winter cover, vetch	1.4 tons air-dried, feed bundle
Total	406.64	73.52		164.46	Total for cotton only	1,360 lb. seed cotton
Average	40.66	7.35		16.45	Average, 3 years	453.3 lb. seed cotton

TABLE 32.—*Annual rainfall, runoff, soil losses, and yields from control plots, 1931–40*—Continued

[Kirvin fine sandy loam, 8.75 percent slope]

Plot No. and year	Rainfall	Surface runoff		Soil loss per acre	Crop and treatment	Yield per acre
		Depth	Percent of rainfall			
Plot 7: [3]	*Inches*	*Inches*	*Percent*	*Tons*		
1931	36.10	3.41	9.45	3.53	Annual lespedeza; winter cover, oats	1.2 tons hay
1932	46.71	8.75	18.73	18.26	Cotton; winter cover, oats, and vetch	400 lb. seed cotton
1933	44.29	8.31	18.76	21.64	Corn; winter cover, rye, barley, oats	9.7 bu. corn
1934	35.18	5.98	17.00	9.26	Annual lespedeza; winter cover, rye, barley, oats	.7 ton hay
1935	48.48	10.93	22.55	33.77	Cotton; winter cover, vetch	460 lb. seed cotton
1936	34.17	7.38	21.60	39.31	Sorghum; winter cover, vetch [5]	1.83 tons sorghum
1937	38.52	5.04	13.08	8.3[illegible]	Cowpeas; winter cover, vetch	133 lb. peas in hull
1938	32.43	6.54	20.17	23.17	Cotton; winter cover, vetch	350 lb. seed cotton
1939	37.14	5.10	13.73	13.10	Sorghum; winter cover, vetch	1.43 tons hay
1940	53.62	7.43	13.85	5.73	Cowpeas; winter cover, vetch	640 lb. peas in hull
Total	406.64	68.87		176.15	Total for cotton only	1,210.0 lb. seed cotton
Average	40.66	6.89	16.95	17.62	Average, 3 years	403.3 lb. seed cotton
Plot 8: [3]						
1931	36.10	0.91	2.52	0.50	Continuous Bermuda grass, clipped	No yield taken
1932	46.71	.87	1.86	.10	do	Do
1933	44.29	.15	.34	.03	do	Do
1934	35.18	.25	.71	.05	do	Do
1935	48.48	.23	.47	.03	do	Do
1936	34.17	.41	1.20	.032	do	Do
1937	38.52	.29	.75	.02	do	Do
1938	32.43	.39	1.20	.02	do	Do
1939	37.14	.15	.40	0	do	Do
1940	53.62	.43	.80	.002	do	Do
Total	406.64	4.08		.784		Do
Average	40.66	.41		.078		Do
Plot 9: [3]						
1931	36.10	4.99	13.82	15.00	Hard, bare fallow	No crop
1932	46.71	10.86	23.25	13.32	do	Do
1933	44.29	7.30	16.48	8.66	do	Do
1934	35.18	4.74	13.47	4.10	do	Do
1935	48.48	10.71	22.09	40.77	Soft, bare fallow	Do
1936	34.17	7.68	22.48	54.84	do	Do
1937	38.52	6.57	17.06	9.06	do	Do
1938	32.43	6.89	21.25	36.13	do	Do
1939	37.14	5.11	13.76	14.19	do	Do
1940	53.62	8.76	16.34	23.88	do	Do
Total	406.64	73.61		219.95		Do
Average	40.66	7.36	18.10	22.00		Do

Plot 10:[3]						
1931	36.10	6.35	17.59	47.25	Desurfaced,[6] cotton fertilized; oat cover crop.	182 lb. seed cotton
1932	46.71	15.68	33.57	57.68	Desurfaced, cotton fertilized; oat and vetch crop.	170 lb. seed cotton
1933	44.29	9.25	20.89	63.15	Desurfaced, cotton fertilized; oat, rye, barley.	440 lb. seed cotton
1934	35.18	9.63	27.37	27.69	Desurfaced, cotton fertilized; oat, rye, barley.	90 lb. seed cotton
1935	48.48	16.10	33.21	59.88	Desurfaced, cotton fertilized; vetch[5] cover crop.	220 lb. seed cotton
1936	34.17	7.49	21.92	71.77	Desurfaced, cotton fertilized; vetch cover crop.	120 lb. seed cotton
1937	38.52	7.75	20.12	41.94	Desurfaced, cotton fertilized; vetch cover crop.	140 lb. seed cotton
1938	32.43	8.53	26.30	59.42	Desurfaced, cotton fertilized; vetch cover crop.	140 lb. seed cotton
1939	37.14	5.64	15.19	38.80	Desurfaced, cotton fertilized; vetch cover crop.	95 lb. seed cotton
1940	53.62	15.36	28.64	87.77	Desurfaced, cotton fertilized; vetch cover crop.	20 lb. seed cotton
Total	406.64	101.78		555.35		1,617.0 lb. seed cotton
Average	40.66	10.18		55.54		161.7 lb. seed cotton
Plot 11:[3]						
1931	36.10	6.08	16.84	58.72	Desurfaced,[6] cotton fertilized[4]	167 lb. seed cotton
1932	46.71	12.71	27.21	68.69	do	200 lb. seed cotton
1933	44.29	9.31	21.02	75.67	do	400 lb. seed cotton
1934	35.18	9.66	27.46	46.79	do	50 lb. seed cotton
1935	48.48	13.81	28.49	76.39	do	150 lb. seed cotton
1936	34.17	8.58	25.11	74.48	do	80 lb. seed cotton
1937	38.52	8.65	22.46	39.08	do	80 lb. seed cotton
1938	32.43	8.78	27.07	65.04	do	260 lb. seed cotton
1939	37.14	7.57	20.38	42.77	do	110 lb. seed cotton
1940	53.62	16.45	30.68	80.75	do	80 lb. seed cotton
Total	406.64	101.60		628.38		1,577 lb. seed cotton
Average	40.66	10.16	24.99	62.84		157 lb. seed cotton
Plot 12:[3]						
1931	36.10	6.64	18.39	61.11	Desurfaced,[6] cotton fertilized[4]	19 lb. seed cotton
1932	46.71	12.92	27.66	74.80	do	50 lb. seed cotton
1933	44.29	10.23	23.10	81.08	do	90 lb. seed cotton
1934	35.18	9.89	28.11	44.18	do	40 lb. seed cotton
1935	48.48	12.57	25.93	55.88	Desurfaced, cotton fertilized, ridge culture	160 lb. seed cotton
1936	34.17	8.59	25.14	70.59	Desurfaced, cotton fertilized, smooth culture	100 lb. seed cotton
1937	38.52	7.35	19.08	24.51	do	115 lb. seed cotton
1938	32.43	9.14	28.18	59.31	do	130 lb. seed cotton
1939	37.14	8.07	21.73	42.77	do	135 lb. seed cotton
1940	53.62	18.28	34.09	70.65	do	130 lb. seed cotton
Total	406.64	103.68		584.88		969.0 lb. seed cotton
Average	40.66	10.37		58.40		96.9 lb. seed cotton

[1] Short plot 36.3 x 6 feet, 1/200 acre.
[2] Long plot 145.2 x 6 feet, 1/50 acre.
[3] Standard length plot including plots, 6, 7, 8, 9, 10, 11, and 12 which are 72.6 x feet, 1/100 acre.
[4] A uniform fertilizer treatment of 400 lb. per acre of 4-8-4 at time of planting.
[5] Superphosphate 100 lb. per acre applied at time of seeding vetch cover crop.
[6] Topsoil removed to subsoil on all desurfaced plots.

TABLE 33.—*Annual rainfall, surface runoff, soil loss, and yields from control plots, 1933–40*

[Kirvin fine sandy loam, 16.5-percent slope]

Plot No. and year	Rainfall	Surface runoff: Depth	Surface runoff: Percent of rainfall	Soil loss per acre	Crop and treatment	Yield of seed cotton per acre
	Inches	*Inches*	*Percent*	*Tons*		*Pounds*
Plot 1: [1]						
1933	48.91	3.87	7.91	26.04	Continuous cotton	1,400
1934	37.22	3.03	8.14	21.82	do	140
1935	49.56	7.50	15.37	71.25	Continuous cotton, fertilized [3]	340
1936	36.29	4.52	12.46	59.05	do	660
1937	38.42	3.07	7.99	9.60	do	300
1938	32.07	4.75	14.81	38.10	do	540
1939	36.96	4.38	11.84	33.56	do	440
1940	52.42	7.76	14.80	56.10	do	720
Total	331.85	38.97		316.42		4,600
Average	41.48	4.87	11.74	39.55		575
Plot 2: [2]						
1933	48.91	6.13	12.53	41.52	Continuous cotton	920
1934	37.22	3.99	10.72	32.05	do	120
1935	49.56	9.09	18.34	127.09	Continuous cotton, fertilized [3]	370
1936	36.29	5.93	16.33	86.90	do	450
1937	38.42	4.05	10.54	20.11	do	430
1938	32.07	5.31	16.57	58.18	do	300
1939	36.96	4.74	12.82	45.54	do	360
1940	52.42	8.52	16.26	76.40	do	580
Total	331.85	47.76		488.45		3,620
Average	41.48	5.97	14.39	61.06		452
Plot 3: [1]						
1933	48.91	0.18	0.37	0.01	Bermuda grass, clipped [4]	
1934	37.22	.07	.20	.01	do	
1935	49.56	.06	.12	0	do	
1936	36.29	.08	.23	.01	do	
1937	38.42	.04	.10	.01	do	
1938	32.07	.04	.12	0	do	
1939	36.96	.05	.13	0	do	
1940	52.42	.33	.63	.004	do	
Total	331.85	.85		.044		
Average	41.48	.11		.006		

[1] Short plot, 30.3 x 6 feet, 1/200 acre.
[2] Standard length plot, 72.6 x 6 feet, 1/100 acre.
[3] A uniform treatment of 400 lbs. per acre of 4-8-4 fertilizer at time of planting.
[4] No yield taken.

Table 34.—*Annual rainfall, surface runoff, soil loss, and yields from control plots, 1932–40*

[Nacogdoches fine sandy loam, 10-percent slope]

Plot No. and year	Rainfall	Surface runoff		Soil loss per acre	Crop and treatment	Yield of seed cotton per acre
		Depth	Percent of rainfall			
	Inches	*Inches*	*Percent*	*Tons*		*Pounds*
Plot 1:[1]						
1932	46.64	7.01	15.03	3.32	Continuous cotton	320
1933	45.86	7.08	16.75	8.44	do	840
1934	35.31	6.05	17.13	4.72	do	140
1935	49.47	8.69	17.57	10.94	Continuous cotton, fertilized[2]	350
1936	34.42	4.20	12.20	2.54	do	420
1937	39.43	5.41	13.72	3.57	do	320
1938	32.68	5.57	17.04	6.50	do	400
1939	36.94	2.77	7.50	2.09	do	440
1940	54.41	7.43	13.65	7.08	do	820
Total	375.16	54.81		50.10		4,050
Average	41.68	6.09	14.61	5.57		450
Plot 2:[3]						
1932	46.64	7.75	16.62	4.22	Continuous cotton	275
1933	45.86	8.15	17.77	10.62	do	680
1934	35.31	5.52	15.63	4.51	do	80
1935	49.47	8.82	17.82	11.68	Continuous cotton, fertilized[2]	360
1936	34.42	4.64	13.47	9.89	do	450
1937	39.43	4.44	11.26	1.99	do	348
1938	32.68	4.58	14.01	5.50	do	340
1939	36.94	1.74	4.71	1.97	do	480
1940	54.41	6.47	11.89	7.80	do	790
Total	375.16	52.11		58.18		3,783
Average	41.68	5.79	13.89	6.46		420
Plot 3:[3]						
1932	46.64	.800	1.72	.010	Bermuda grass, clipped[4]	
1933	45.86	.074	.16	0	do	
1934	35.31	.100	.28	0	do	
1935	49.47	.092	.19	0	do	
1936	34.42	.056	.16	.012	do	
1937	39.43	.050	.13	0	do	
1938	32.68	.030	.09	0	do	
1939	36.94	.014	.04	0	do	
1940	54.41	.041	.08	.003	do	
Total	375.16	1.257		.035		
Average	41.68	.140	.34	.004		
Plot 4:[3]						
1932	46.64	9.87	21.16	29.80	D urfaced,[5] continuous cotton	20
1933	45.86	8.69	18.95	41.25	do	10
1934	35.31	9.05	25.63	24.16	do	Trace
1935	49.47	13.10	26.48	34.70	Desurfaced, continuous cotton, fertilized.[2]	120
1936	34.42	5.68	16.50	20.62	do	130
1937	39.43	5.31	13.47	11.27	do	70
1938	32.68	7.18	21.97	17.01	do	120
1939	36.94	4.09	11.07	7.03	do	180
1940	54.41	14.74	27.09	25.13	do	430
Total	375.16	77.71		220.06		1,080
Average	41.68	8.63		24.45		120

[1] Short plot, 36.3 x 6 feet, 1/200 acre.
[2] A uniform fertiliz - treatment of 400 lbs. per acre of 4-8-4 fertilizer applied at time of planting.
[3] Standard length plot, 72.6 x 6 feet, 1/100 acre.
[4] No yield taken.
[5] Desurfaced to subsoil.

TABLE 35.—*Annual rainfall, surface runoff, soil loss from 1/100-acre wooded control plots, 1932–40*

[Kirvin fine sandy loam, 12.5-percent slope]

Plot No., cover, and year	Rainfall	Surface runoff		Soil loss per acre
		Depth	Percent of rainfall	
	Inches	*Inches*	*Percent*	*Pounds*
Plot 1: Native hardwood, area burned annually in March:				
1932	45.62	1.50	3.29	140
1933	40.15	1.16	2.51	820
1934	34.81	.76	2.18	150
1935	48.88	1.43	2.93	1,160
1936	33.97	.78	2.30	610
1937	38.75	.70	1.81	360
1938	32.15	1.05	3.27	1,560
1939	36.08	.65	1.80	430
1940	52.15	1.57	3.01	1,200
Total	368.56	9.60		6,430
Average	40.95	1.07	2.61	714
Plot 2: Area not burned:				
1932	45.62	.72	1.58	60
1933	40.15	.09	.20	20
1934	34.81	.08	.23	400
1935	48.88	.15	.31	140
1936	33.97	.10	.28	160
1937	38.75	.03	.08	20
1938	32.15	.03	.09	10
1939	36.08	0	0	0
1940	52.15	.02	.04	10
Total	368.56	1.22		820
Average	40.95	.14		91

TABLE 36.—*Seasonal runoff and soil losses from control plots*

[16.5-percent slope, Kirvin fine sandy loam]

Year and period	Rainfall producing runoff	Plot 1		Plot 2		Plot 3	
		Surface runoff	Soil loss per acre	Surface runoff	Soil loss per acre	Surface runoff	Soil loss per acre
	Inches	*Inches*	*Pounds*	*Inches*	*Pounds*	*Inches*	*Pounds*
1932:							
1st quarter	14.31	2.52	9,278	2.70	1,571	0.15	0
2d quarter	5.50	.12	760	.18	6,408	.02	0
3d quarter	2.15	.05	0	.21	5,610	.01	0
4th quarter	11.21	2.32	16,240	3.18	32,610	4.60	60
Total	33.17	5.01	25,278	6.27	46,499	4.78	60
1933:							
1st quarter	6.31	.84	5,304	1.23	13,707	.10	4
2d quarter	8.63	1.01	38,372	1.56	54,962	.04	2
3d quarter	10.85	1.22	6,742	1.79	12,718	.03	0
4th quarter	9.28	.81	1,506	1.55	1,271	.02	0
Total	35.07	3.88	51,924	6.13	82,658	.19	6
1934:							
1st quarter	10.33	.39	332	.67	341	.02	0
2d quarter	7.87	1.02	22,878	1.45	30,177	.03	0
3d quarter	1.43	.15	1,442	.24	4,627	.00	0
4th quarter	7.03	1.49	3,538	1.62	29,374	.01	0
Total	26.66	3.05	28,190	3.98	64,519	.06	0
1935:							
1st quarter	7.45	.97	19,282	1.34	40,392	.01	0
2d quarter	13.83	2.85	81,686	3.30	135,950	.02	0
3d quarter	4.93	.41	9,002	.59	28,911	.01	0
4th quarter	13.65	3.36	32,154	3.88	17,790	.05	0
Total	39.86	7.59	142,194	9.11	223,043	.09	0
1936:							
1st quarter	.88	.18	1,326	.17	5,890	.02	0
2d quarter	10.05	1.98	105,762	2.36	143,516	.02	0
3d quarter	7.02	.47	2,490	.85	5,304	.02	0
4th quarter	10.73	1.89	19,050	2.54	18,556	.02	0
Total	28.48	4.52	128,628	5.92	173,266	.08	0
1937:							
1st quarter	6.31	.83	2,146	1.13	2,826	.01	0
2d quarter	3.26	.46	5,502	.70	12,296	.02	0
3d quarter	4.71	.35	1,978	.64	5,087	.00	0
4th quarter	11.09	1.42	9,464	1.58	19,750	.02	0
Total	25.37	3.06	19,090	4.05	39,959	.05	0
1938:							
1st quarter	7.71	2.47	37,300	2.57	64,538	.03	0
2d quarter	7.42	1.00	18,646	1.16	27,490	.01	0
3d quarter	2.23	.49	8,344	.58	10,306	.00	0
4th quarter	6.76	.78	11,676	.91	13,484	.00	0
Total	24.12	4.74	75,972	5.32	115,818	.04	0
1939:							
1st quarter	11.44	1.55	20,174	1.66	21,834	.02	0
2d quarter	4.30	.74	13,118	.84	20,211	.02	0
3d quarter	2.64	.79	21,508	.86	32,155	.00	0
4th quarter	9.07	1.30	12,142	1.38	16,438	.01	0
Total	27.51	4.38	66,942	4.74	90,638	.05	0
1940:							
1st quarter	4.60	.48	11,040	.43	11,790	.03	0
2d quarter	9.44	1.59	39,012	1.40	44,460	.04	0
3d quarter	14.00	3.27	60,674	3.77	89,111	.16	0
4th quarter	17.12	2.46	5,176	3.10	7,115	.11	0
Total	45.25	7.80	115,902	8.70	152,476	.34	0

TABLE 37.—*Seasonal runoff and soil losses from control plots by quarterly rains 1932–1940*

[10-percent slope, Nacogdoches fine sandy loam]

Year and period	Rainfall producing runoff	Plot 1		Plot 2		Plot 3		Plot 4	
		Surface runoff	Soil loss per acre	Surface runoff	Soil loss per acre	Surface runoff	Soil loss per acre	Surface runoff	Soil loss per acre
	Inches	*Inches*	*Pounds*	*Inches*	*Pounds*	*Inches*	*Pounds*	*Inches*	*Pounds*
1932:									
1st quarter	15.96	3.33	1,058	3.49	690	0.70	5	0.77	1,823
2d quarter	4.27	.51	0	.02	0	.01	0	.02	0
3d quarter	4.69	.46	1,080	.35	670	.01	0	.32	3,638
4th quarter	12.57	3.17	4,220	3.88	6,750	.04	0	6.19	46,329
Total	37.49	7.47	6,358	7.74	8,119	.82	5	7.30	51,778
1933:									
1st quarter	8.67	.91	2,254	1.04	3,841	.02	0	1.02	6,974
2d quarter	6.10	1.30	6,022	1.36	8,094	.01	0	.82	15,304
3d quarter	12.39	4.18	7,844	4.36	8,398	.02	0	3.49	41,638
4th quarter	9.62	1.30	472	1.39	607	.02	0	3.34	18,016
Total	36.18	7.69	16,592	8.15	20,940	.07	0	8.67	81,032
1934:									
1st quarter	11.73	1.04	408	.91	412	.06	0	4.34	12,296
2d quarter	7.05	2.01	5,420	1.74	4,946	.02	0	2.12	16,630
3d quarter	1.36	.28	638	.27	571	.00	0	.12	1,474
4th quarter	7.31	2.73	2,634	2.60	2,901	.02	0	2.48	17,530
Total	27.45	6.06	9,190	5.52	8,830	.10	0	9.06	47,930
1935:									
1st quarter	7.69	1.15	3,232	1.01	3,521	.01	0	1.31	13,738
2d quarter	13.49	3.27	12,414	3.43	12,022	.04	0	3.49	25,373
3d quarter	5.33	.86	4,206	.82	5,201	.02	0	.83	10,750
4th quarter	13.20	3.38	2,026	3.76	1,440	.06	0	[1] 7.54	19,102
Total	39.71	8.66	21,878	9.02	23,084	.13	0	13.17	68,963
1936:									
1st quarter	72	.00	234	.08	230	.01	0	.08	414
2d quarter	9.62	1.05	2,576	1.03	16,905	.02	0	1.68	37,523
3d quarter	6.61	.79	1,026	.70	1,128	.01	0	.86	7,904
4th quarter	10.44	2.26	1,008	1.92	1,179	.02	0	3.05	12,548
Total	27.39	4.10	5,444	4.03	19,451	.06	0	5.67	58,479
1937:									
1st quarter	8.55	1.16	252	1.03	402	.01	0	1.97	4,356
2d quarter	3.38	.80	2,108	.69	1,576	.01	0	.82	5,776
3d quarter	4.45	1.22	1,706	1.14	872	.00	0	.87	4,888
4th quarter	11.57	2.24	2,874	1.58	946	.03	0	1.64	7,062
Total	27.95	5.42	6,940	4.44	3,796	.05	0	5.30	22,082
1938:									
1st quarter	7.53	2.02	6,654	1.69	6,410	.02	0	3.76	19,727
2d quarter	7.65	1.20	3,062	.99	2,473	.01	0	1.12	7,925
3d quarter	2.50	.84	1,748	.72	1,018	.00	0	.54	3,177
4th quarter	7.10	1.51	1,310	1.18	829	.00	0	1.76	2,821
Total	24.87	5.57	12,774	4.58	10,730	.03	0	7.18	33,650
1939:									
1st quarter	11.64	.66	926	.30	640	.01	0	1.88	2,769
2d quarter	3.83	.84	2,486	.05	1,544	.00	0	.73	4,417
3d quarter	2.94	.77	1,088	.63	1,477	.00	0	.48	6,840
4th quarter	8.77	.50	174	1.68	81	.00	0	.99	413
Total	27.18	2.77	5,274	3.26	3,748	.01	0	4.08	14,439
1940:									
1st quarter	2.86	.30	862	.28	723	.00	0	.20	1,490
2d quarter	9.82	1.46	4,308	1.33	4,874	.00	0	1.74	11,830
3d quarter	14.41	3.18	7,828	2.70	9,460	.01	0	3.98	27,720
4th quarter	18.57	2.28	910	2.00	498	.03	0	9.34	8,572
Total	45.65	7.22	13,908	6.31	15,555	.04	0	15.32	49,612

[1] Seep occurred in plot.

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