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Soil Survey

Maverick County Texas

By
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United States Department of Agriculture, in Charge
and
R. M. MARSHALL and I. C. MOWERY
Texas Agricultural Experiment Station

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
In cooperation with the
Texas Agricultural Experiment Station

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SOIL SURVEY OF MAVERICK COUNTY, TEXAS

By HOWARD M. SMITH, Division of Soil Survey,[1] Bureau of Plant Industry, United States Department of Agriculture, in Charge, and R. M. MARSHALL and I. C. MOWERY, Texas Agricultural Experiment Station

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United States Department of Agriculture in cooperation with the Texas Agricultural Experiment Station

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COUNTY SURVEYED

Maverick County is in southwestern Texas, adjacent to the Rio Grande, the international boundary between the United States and Mexico (fig. 1). It is part of that section of Texas locally referred to as the Winter Garden district. Eagle Pass, the county seat and largest city, is a port of entry from Mexico, on the Rio Grande at the western edge of the county, opposite Piedras Negras, Coahuila, Mexico. It lies about 150 miles southwest of San Antonio, the regional metropolis, and 280 miles northwest of Corpus Christi, the nearest seaport on the Gulf of Mexico. The area of the county is 1,278 square miles, or 817,920 acres.

The county lies in the southwestern part of the Rio Grande Plain, a smoothly undulating to gently rolling subdivision of the Coastal Plain province, which extends southeastward from the Edwards Plateau to the Gulf of Mexico. The general regional slope is southeasterly. In places within the county the normal plain has been modified through earth movements that caused faults. These faults are apparent on the surface, in the form of bluffs near the Rio

[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

Grande and some of the smaller tributary creek valleys. The escarpments face west or northwest and are prominent physiographic features.

The western half of the county is drained by the Rio Grande, and the eastern half lies in the Nueces River drainage basin. The valley of the Rio Grande is deep and wide, but valleys of the other streams are narrow and relatively shallow, with the uplands rising gradually and smoothly from them, except for the bluffs mentioned above. Interior drainageways penetrate most parts of the county and are dendritic in pattern. All streams of the area are intermittent in flow except the Rio Grande and Las Moras Creek, the latter being fed by springs near its source in Kinney County.

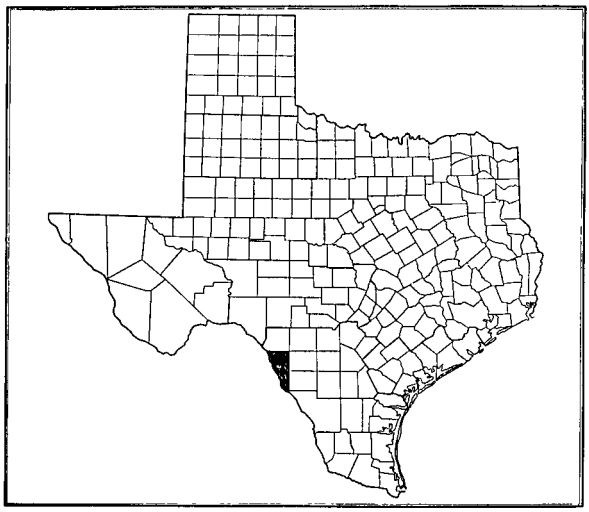

FIGURE 1.—Sketch map showing location of Maverick County, Tex.

Two large areas of very smooth upland, which are not so thoroughly dissected as the rest of the county, occupy the north-central part. Within these areas are several large depressions, locally called lagunas. These lagunas represent shallow sinks or lake beds probably caused by the solution and removal of underlying formations or by buried faults. In rainy seasons they are covered with water. Several similar depressions are in the Rio Grande Valley about 2 miles southeast of Quemado.

Elevations of the area above sea level range from approximately 540 feet[2] at the Maverick-Webb County line on the Rio Grande to 956 feet[3] atop the Rio Grande-Neuces River divide at Nora. Other known elevations are 740 feet[4] at the Eagle Pass railway express office, 825 feet[3] at Indio primary triangulation station about 3¾ miles southwest of Old Indio ranch, 778 feet[5] on the Rio Grande at the Maverick-Kinney County line, and 778 feet[6] at the intersection of the old road between Eagle Pass and Carrizo Springs, in Dimmit County, and an abandoned telephone line in section 70, block 6 of the International-Great Northern Railroad surveys.

[2] United States Army topographic sheet, Texas Ford quadrangle, grid zone D.
[3] Elevation at top of rail, Southern Pacific Company data.
[4] Bench marks, U. S. Coast and Geodetic Survey.
[5] Unpublished location data, main irrigation canal, Maverick County Water Control and Improvement District No. 1, Eagle Pass, Tex.
[6] Bench mark, U. S. Geological Survey.

The native vegetation consists mainly of small trees, brush, and short grasses common to the subhumid and semiarid regions of the southwestern part of the United States and northern Mexico. Some plants and trees indigenous to the humid regions grow in places where conditions are similar to those of their natural habitat. Such trees include live oak, elm, ash, hackberry, willow, and possibly a few others, most of which grow along the banks of the river, creeks, and slough channels of the county, where they obtain sufficient moisture for growth. The rest of the valleys and uplands are occupied by plants characteristic of dry regions. This plant association is largely of mesquite trees, together with curly mesquite, red grama, and three-awn grasses. The grass cover occupies from 5 to 50 percent of the land surface. The density and size of plant growth vary with the depth and character of the soils, as well as with the amount of available moisture. The native cover throughout the region remains unchanged except for modifications brought about by the grazing of livestock and fencing of the range and for the comparatively small areas cleared for cultivation. It is reported that since the range was fenced, the brush growth has become denser at the expense of the area of grass cover. Grazing tends to reduce or eliminate the more palatable and thus more valuable plants, whereas the less desirable ones increase. It is doubtful, however, whether these modifications have influenced greatly the carrying capacity of the range. Many of the shrubs that have increased in numbers make valuable browse and furnish a more dependable supply of nourishment than do the grasses, because they survive better the long dry periods common to the region.

Many Mexicans utilize the native brush cover as a source of food, clothing, fuel, medicine, and housing material. Certain plants, chiefly whitebrush, guajillo, catclaw, beebalm or horsemint, and huisache, are valuable for the quality of the honey produced from their nectar.

Many of the native plants are valuable, but some that are valuable in one respect are undesirable in another. Bermuda grass, mesquite, red grama, buffalo grass, tobosa, crowfoot, field sandbur or grassbur, hairy grama, and three-awn grasses provide much of the grazing. Plantain, hoary pea, gaillardia, bladderpod, and numerous other forbs are valuable grazing plants. Guajillo, blackbrush, mesquite, soapbush or guayacan, huisachillo, catclaw, and rockbrush, with a few others, constitute the chief browse shrubs. Pricklypear is considered by some to be of great value as feed for cattle in time of drought. It is made available by burning off the spines with a torch. Plants that are abundant but of little or no browse or grazing value are tasajillo, asters, sangre de drago or leatherweed, goatweed or crotonweed, broomweed, paloverde, and allthorn. Still other plants are undesirable because they are toxic to livestock when consumed in sufficient quantities. Among these are sneezeweed, bitter rubberweed, whorled milkweed, whitebrush, and a number of others. Many of the plants that are undesirable for livestock are valuable as a source of food and shelter to the native wildlife, including birds.

A large number of species are excellent for ornamental plantings. Many of the shrubs and trees are legumes.

A number of plant communities, associations, or conditions of growth can readily be identified with certain soils. Thus, a small to medium-sized growth of mesquite trees, together with other medium-sized brush species, large-sized pricklypear, and a 50- or 60-percent cover of curly-mesquite and scattered tobosa grasses may be taken as the main characteristic growth on the dark-colored heavy-textured soils, of which Monteola clay is representative. Again, a stunted and sparse stand of mesquite trees or shrubs (trailing mesquite), pricklypear, a carpet of curly mesquite grass and the weed saladillo represent the growth on the saline areas of these soils. On the dark-colored soils of clay loam or coarser texture, represented here by Monteola clay loam, the typical growth may be described as of mesquite trees, desert hackberry or granjeno, huisache, pricklypear (all of medium size), and many open areas of red grama and three-awn grasses. A dominant growth of blackbrush and creosotebush, many less prominent shrubs, and a sparse to fair grass cover, mostly red grama and three-awn grasses, are associated with the light-colored and thin or immature upland soils, such as Zapata fine sandy loam and Maverick clay loam. Scattered large mesquite trees, a few whitebrush, pricklypear, granjeno, guayacan, paloverde, cenizo, and three-awn and red grama grasses grow on the deeper soils (loam to clay loam textures) of the Reagan, Uvalde, and Laredo series. The Uvalde soils, as a rule, support a denser growth than do the Reagan soils. The gravelly soils of the Reagan and Webb series are characterized by an easily recognized association of guajillo, cenizo, and creosotebush. Sangre de drago or leatherweed, cenizo, and paloverde are definitely identified with the more sandy textured soils and curly mesquite grass and *Jatropha cathartica* with the dark-colored soils.

The sloughs and low places in the bottoms are featured by the luxuriant and dense growth of large mesquite trees, granjeno, and whitebrush, and the vega, or low overflow bottoms along the Rio Grande, are a jungle of giant reed or carrizo (*Arundo donax*), desertwillow, willow, *Aster spinosus*, and other more or less succulent and quick-growing shrubs and trees. The open places are carpeted with a dense mat of Bermuda grass, which is not native.

Following is a list of plants[7] known to grow in Maverick County:

GRASSES, RUSHES, AND SEDGES

Scientific name	*Common name*
Andropogon spp.	Beardgrass, broomsedge, or bluestem (several species).
Aristida purpurea	Purple three-awn.
Arundo donax	Giant reed or carrizo.
Bouteloua breviseta	Chino.
Bouteloua curtipendula	Side-oats grama.
Bouteloua hirsuta	Hairy grama.
Bouteloua rigidiseta	Texas grama.
Bouteloua trifida	Red grama.
Bromus catharticus	Rescue grass.
Buchloë dactyloides	Buffalo grass.
Carex planostachys	Sedge.
Cenchrus pauciflorus	Field sandbur or grassbur.

[7] Largely compiled by V. L. Cory, range botanist, and H. B. Parks, chief of the Division of Apiculture, Texas Agricultural Experiment Station.

Chloris cucullata	Fingergrass
Cynodon dactylon[1]	Bermuda grass.
Dactyloctenium aegyptium	Crowfoot.
Distichlis stricta	Desert saltgrass or carpet saltgrass.
Eragrostis hypnoides	Lovegrass or smooth creeping meadow grass.
Eragrostis reptans	Lovegrass or creeping meadow grass.
Eragrostis secundiflora	Lovegrass.
Festuca octoflora	Sixweeks fescue.
Hilaria belangeri	Curly mesquite.
Hilaria mutica	Tobosa.
Juncus sp	Rush.
Panicum obtusum	Vine mesquite.
Panicum texanum	Texas millet or Colorado grass.
Pappophorum bicolor	Pappusgrass.
Setaria macrostachya	Plains bristlegrass or tall foxtail.
Sorghum halepense[1]	Johnson grass.
Sporobolus airoides	Alkali sacaton.
Sporobolus wrightii	Sacaton.
Stipa sp	Needlegrass or speargrass.

FORBS AND WEEDS

Acalypha radians	Falsenettle.
Actinea odorata[2]	Bitter rubberweed or western bitterweed.
Allium sp	Wild onion.
Amaranthus sp	Carelessweed.
Aphanostephus sp	Wild daisy.
Aplopappus drummondii	
Argemone sp	Pricklepoppy.
Asclepias verticillata[2]	Whorled milkweed.
Aster exilis	Aster.
Aster spinosus	Do.
Astragalus sp	Milkvetch (nonpoisonous).
Baileya multiradiata[2]	
Cirsium sp	Thistle.
Croton capitatus	Goatweed, silver croton, or crotonweed.
Draba sp	Whitlowgrass.
Dysodia gracilis	Dogweed.
Dysodia treculii	Do.
Eriogonum sp	Wild buckwheat.
Erodium texanum	Texas filaree.
Euphorbia albomarginata	Rattlesnakeweed.
Euphorbia sp	Spurge.
Evax sp	Cudweed.
Froelichia drummondii	Snake cotton.
Gaillardia sp	Gaillardia or Indian blanket.
Gutierrezia sp	Annual broomweed.
Helenium sp.[2]	Sneezeweed.
Helianthus ciliaris	Sunflower.
Heterotheca subaxillaris	Camphorweed.
Jatropha cathartica	
Lepidium sp	Peppergrass.
Lespedeza sp	Lespedeza.
Lippia incisa	Carpetweed or frog fruit.
Lupinus sp	Lupine or bluebonnet.
Medicago sp	Bur-clover.
Melampodium cinereum	
Melilotus sp.[1]	Sweetclover.
Monarda sp	Beebalm or horsemint.
Nama sp	Nama.
Oenothera sp	Evening-primrose.
Oxalis sp	Sheep sorrel.
Petunia parviflora	
Phlox sp	Phlox.
Polypteris sp	
Psilostrophe gnaphalodes[2]	

[1] Not native.
[2] Toxic to livestock.

Ratibida sp.	Coneflower.
Salsola kali var. *Tenuifolia* (syn. *S. pestifer*)	Russian-thistle.
Salvia sp.	Sage.
Selloa glutinosa[3]	Alkaliweed.
Senecio sp.	Annual groundsel.
Tephrosia lindheimeri	Hoary pea.
Tribulus terrestris	Puncturevine.
Valerianella sp.	Lamb's-lettuce.
Varilla texana[3]	Saladillo.
Verbena sp.	Wild verbena.
Vicia sp.	Peavine.
Zephyranthes texana	Yellow rainlily.
Zexmenia hispida	
Zinnia sp.	Wild zinnia.

SHRUBS

Acacia amentacea	Blackbrush.
Acacia berlandieri	Guajillo.
Acacia farnesiana	Huisache.
Acacia greggii	Long-flowered catclaw.
Acacia roemeriana	Round-flowered catclaw or tree catclaw.
Acacia tortuosa	Catclaw or huisachillo.
Atriplex canescens	Fourwing saltbush or chamiza.
Baccharis salicina[2]	Willow baccharis.
Calliandra eriophylla	False mesquite or lamb brush.
Capsicum baccatum	Chillipiquin or chilli piquin.
Castela texana	Goatbush or amargosa.
Celtis pallida	Desert hackberry or granjeno.
Cephalanthus occidentalis	Buttonball bush or button willow.
Cercidium texanum	Texas paloverde.
Chilopsis linearis	Desertwillow.
Cissus incisa	Treebine, cow itch, or yerba del buey.
Colubrina texensis	Hog-plum.
Condalia obovata	Bluewood or brasil.
Condalia obtusifolia	Texas lotebush or Texas buckthorn.
Condalia spathulata	Squawbush.
Covillea tridentata	Creosotebush.
Ephedra sp.	Jointfir or Mormon tea.
Eysenhardtia texana	Rockbrush.
Ibervillea tenuisecta	Snake apple.
Jatropha spathulata	Sangre de drago, dragon's blood, or leatherweed.
Koeberlinia spinosa	Allthorn.
Lantana camara	Common lantana.
Lantana macropoda	Lantana.
Lesquerella recurvata	Bladderpod, popweed, or cloth-of-gold.
Leucophyllum frutescens	Cenizo.
Lippia ligustrina	Whitebrush.
Lycium sp.	Tomatillo.
Porlieria angustifolia	Soapbush or guayacan.
Rhus microphylla	Small-leaf sumac.
Rivina humilis	Rouge-plant or pigeonberry.
Schaefferia cuneifolia	Desert yaupon.
Sida lepidota	
Yucca sp.	Beargrass.
Yucca treculeana	Spanish-dagger.

TREES

Carya pecan	Pecan.
Celtis occidentales var. *reticulata* (syn. *C. reticulata*)	Paloblanco or hackberry.
Diospyros texana	Black persimmon or Mexican persimmon.

[2] Toxic to livestock.
[3] Salt-tolerant.

Fraxinus berlandieriana	Mexican ash.
Juglans rupestris	Texas walnut or little walnut.
Morus rubra	Red mulberry.
Parkinsonia aculeata	Horsebean, Jerusalem-thorn, or retama.
Prosopis chilensis	Mesquite.
Prunus minutiflora	Texas almond or wild plum.
Quercus virginiana	Live oak.
Salix sp	Willow.
Sapindus drummondii	Western soapberry or wild chinaberry.
Tamarix gallica[4]	French tamarix or saltcedar.
Ulmus crassifolia	Cedar elm.

CACTI[5]

Opuntia lindheimeri	Pricklypear.
Opuntia leptocaulis	Tasajillo.

[4] Not native to this part of the State.
[5] Other species occur, but these are the most common.

According to records, the first settlement of whites in the area now included in Maverick County was made by an English syndicate, which sent a colonizing party of men and women under a concession from the Spanish Government to a point on Las Moras Creek. This colony was established in 1834, and Mexican guards were hired to protect it from raiding Indians. After 2 years of peaceful development, the settlement was abandoned by the Englishmen during the Texas revolution. The small band, endeavoring to reach a Texas stronghold, was attacked by Comanche Indians, who massacred most of them, carrying the women and children into captivity. For many years prior to this there had been passage through the county on the Camino Real, a highway from Mexico to eastern Texas. A mission was established by the Franciscan Friars in 1669 a few miles south of the Rio Grande at Guerrero.

Texas gained her independence from Mexico in 1836, but the boundary between the two nations was disputed until 1848, at the close of the war between the United States and Mexico. After gaining her independence, Texas respected the titles to the land grants previously made within her territory by Mexico. When Texas became a State in the Union, it was agreed that these titles remain valid and the unallotted lands or public domain within the boundaries of the State should continue as the property of the State. Since then the public domain has been allotted to railroads as subsidies to induce and aid their construction, traded for the construction of public buildings, allotted to the public-school system for its support, and sold. Today, the original Spanish grants, together with the various subdivisions of the public domain as enumerated above, remain the basis for the survey system in effect. In all deeds and survey records the Spanish system of measure is still used. The common land-measuring unit is the vara (33.33 inches).

In 1849 Fort Duncan was established on the banks of the Rio Grande about 4 miles below the present site of Eagle Pass. With the establishment of a definite international boundary and the fort, settlement of the surrounding territory that now comprises Maverick County became more rapid. People of Spanish, English, German, Scotch, and Scotch-Irish descent came from other parts of Texas and the United States, Mexico, and direct from Europe. Descendants of these make up the present population. The first ranch house was

built in 1861 about 4 miles northwest of what is now Paloma station on the railroad.

Maverick County was created by separation from the Municipality of Bexar on February 2, 1856; but it was not organized until July 13, 1871, at which time Eagle Pass became the county seat. From the earliest period of occupancy, which predates Texan independence (1836), the vast southwestern Texas border region, which includes Maverick County, was an unfenced livestock domain. Both cattle and sheep grazed in roving herds close to adequate natural water supplies, particularly the larger stream courses. After 1849, permanent settlements and ranches were established. Development was slow, however, until barbed wire became available for fencing. The fencing activity that took place in the eighties led to the acquisition of large tracts of land under private ownership and made livestock raising more stable.

When the railroad reached Eagle Pass, the importance of trade with Mexico increased and some of the valley land along the Rio Grande was cleared and irrigated for the production of commercial crops. Lignitic noncoking coal beds in the vicinity were exploited. About 1920 the market for this coal, much of which remains, was closed by competition from other fuels, but the other activities continued to expand. Piedras Negras, lying in Mexico directly across the Rio Grande from Eagle Pass, derives its name from the presence of coal beds.

The population of the county according to the census of 1930 was 6,120. Since then the figure has been increased several thousand by reason of the opening and settlement of the Quemado Valley, as well as other units of a gravity irrigation system. About one-fifth of the population is native white; the rest is largely Mexican. Most of the inhabitants reside in Eagle Pass and the Quemado Valley, and a few are scattered thinly over the rest of the county, living on ranches. The last census reports only 1,061 persons classed as rural.

Eagle Pass, with a population of 5,059, is the principal town. Quemado, a new town in the Quemado Valley and the second largest, has about 300 inhabitants. Normandy and El Indio are small new towns in the recently opened irrigation district. Hopedale and Olmos are former mining communities; and Paloma, Darling, and Nora are livestock-loading points on the railroad. Although car loadings are made at several other points, Eagle Pass is at present the only shipping point.

Eagle Pass and Quemado Valley are served by a branch line extending from the main line of the Southern Pacific Company, about 40 miles to the north, which connects at Eagle Pass with a Mexican railroad system that completes an important international artery of commerce. A number of hard-surfaced roads of the State system radiate from Eagle Pass and connect with the Nation-wide network. Although a fine bridge for vehicles and pedestrians spans the Rio Grande at Eagle Pass and gives access to Piedras Negras on the Mexican side, roads leading to the interior of Mexico from this point are, as yet, unimproved. In Maverick County a few graveled and graded county roads connect the chief farm communities and ranches, but many ranch roads are mere trails. Usually, except in wet weather, the latter can be traveled by motor vehicles. All farm products, including cattle, move from the county by truck and rail.

Much of the perishable produce, such as spinach, is shipped by rail in refrigerator cars, which are iced locally. Most of the cattle move to distant markets by rail, but some go by truck to San Antonio or other points in the State. Transportation facilities are adequate for marketing the products of the county at present, but an increase in cropland, as indicated by the newly completed gravity irrigation system, may necessitate the extension of both rail and motor roads.

All towns and communities are connected by telephone, and many privately owned lines reach farm homes and ranch headquarters. The rural homes are simple but comfortable, and many are equipped with modern conveniences. Mexican laborers usually occupy rather primitive shelters.

Schools and churches are in Eagle Pass, Quemado, Normandy, and El Indio. The public schools are of consolidated type, and busses carry many students to and from the outlying districts. Most of the pupils living beyond the bus routes establish residence in town during the school term.

Industries exploiting natural nonagricultural resources include a hydroelectric plant of 12,000-horsepower capacity, operating in connection with the gravity irrigation system; a natural-gas field, of 38,000,000 cubic feet daily production, which supplies a number of surrounding cities, including Eagle Pass; two artificial-ice manufacturing plants, which supply ice for icing vegetable cars shipped from the county and for re-icing those en route from Mexico; and the production of building sand, caliche, and gravel. Much coal has been taken from the underlying beds and much remains, but none is being mined at present.

CLIMATE

Maverick County lies within the warm temperate semiarid region. The climate is continental because of the location so far inland, although it is influenced to some degree by winds from the Gulf. It is characterized by short mild winters and long hot summers.

Rather wide fluctuations in temperature occur, both in winter and in summer. In winter, when cold waves (northers) sweep in, the temperature may fall 50° in 6 or 7 hours, but rising temperatures generally are slow and regular. It is not uncommon for summer temperatures to rise above 100° F. at midday and remain that high until late evening. Generally, such temperatures are mitigated somewhat by the relatively low humidity and the Gulf breezes that stir at night.

Precipitation, mainly in the form of rain, is irregular, both within the annual cycle and from year to year. Humidity and precipitation are greatest in the spring and fall, especially in May, June, and September. Electric storms sometimes occur during these months. Local rainfall amounting to 18 inches within a period of 36 hours has been recorded, but some entire years have passed with less than half that amount. Destructive hailstorms occur occasionally. Except for an annual average snowfall of 0.6 inch, precipitation during the winter is in the form of gentle showers, slow rains, mists, or fogs, all lasting for more or less extended periods without the accumulation of much total water in the soil. On most ranches earth reservoirs

capture sufficient supplies of rain water for livestock. In many places these reservoirs are the only means for conserving water.

March and April are recognized as windy months. North winds, similar to those of winter but accompanied by diminished coolness, occur frequently, and these materially reduce the moisture content of the soils. Occasionally they are laden with much fine dust gathered in the wake of retreating frost and snow at points farther north.

The average frost-free period is 274 days, extending from February 26, the average date of the latest, to November 27, the average date of the earliest. Frost has been recorded as late as April 5 and as early as October 20. The mean annual temperature is 71.3° F., and the mean annual precipitation is 21.49 inches. As indicated in table 1, it may be concluded that the climate as a whole fluctuates widely. It is typical semiarid climate in which systematic crop production by dry-farming methods is impossible.

Irrigation removes many of the climatic obstacles to crop production and makes available the long frost-free period, which is favorable to the growing of several crops in one year. Growing winter vegetables for northern markets and spring and summer feed crops for local use, under irrigation, is satisfactory. Except on wet, heavy soils, tillage is possible at any time of the year.

The nutritious native grasses and shrubs and the mild winter form an advantageous combination for the production of range livestock. At present, by far the greater part of the land in the county is used for this purpose.

Table 1, compiled from records of the United States Weather Bureau station at Eagle Pass, gives climatic data for Maverick County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Eagle Pass, Maverick County, Tex.*

[Elevation, 743 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1893)	Total amount for the wettest year (1900)
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*
December	52.8	92	16	0.82	0.11	0.22
January	53.1	92	11	.70	1.01	2.08
February	57.1	101	7	.74	.32	.25
Winter	54.3	101	7	2.26	1.44	2.55
March	65.0	106	20	.94	.31	4.00
April	72.8	106	32	1.93	.11	8.10
May	79.4	114	42	3 30	1.42	8.15
Spring	72.4	114	20	6.17	1.84	20.25
June	85.1	115	47	2.80	0	3.20
July	87.5	111	60	1.83	(1)	1.70
August	87.2	112	60	1.95	1.90	2.56
Summer	86.6	115	47	6.58	1.90	7.46
September	82.0	108	44	3.26	1.66	8.20
October	72.3	106	27	1.95	0	5.50
November	61.2	100	19	1.27	.19	.40
Fall	71.8	108	19	6.48	1.85	14.10
Year	71.3	115	7	21.49	7.03	44.36

[1] Trace.

AGRICULTURAL HISTORY AND STATISTICS

From the earliest settlement to the present time, the chief agricultural pursuit of the vast territory including Maverick County has been the production of range livestock. Beef cattle, long-wooled sheep, and Angora and short-haired goats are raised; consequently, the area is occupied to a very large extent by ranches rather than farms. A very small proportion of the land, chiefly in the smooth valleys of the Rio Grande, has been used for years for the production of cultivated crops under irrigation.

In the early days sheep outnumbered cattle on the range, but by 1900 sheep raising throughout the entire region had declined materially, owing, according to local information, to a series of severe droughts and low prices; but during the last 10 to 15 years sheep raising has again become important in this county. Cattle raising was greatly retarded by the same conditions but managed to survive.

Fencing the range in the eighties gradually brought about certain improvements. The fenced pastures were equipped with more adequate watering places consisting of earth reservoirs and wells with pumps. These increased the carrying capacity of the range and encouraged improvement in the quality of the livestock. The early cattle were native stock known as Longhorns. These were followed by Durhams, but they never fully displaced the Longhorns. About 20 years ago the Hereford breed (pl. 1, *A*) was introduced and proved extremely well suited to the local range environment, and it rapidly became the chief breed. Except for low-quality steers of nondescript breeding, which are at times imported from Mexico when market conditions are favorable, the Hereford is the principal breed on the ranches.

Because of the dense brush cover, most of the range is considered more suited to fattening steers than to breeding cattle, and for this reason many young steers are purchased outside the county and pastured here for a period ranging from 18 months to 2 years, after which they are moved to the Corn Belt States for finishing on grain before being marketed. At present there is a tendency to finish some of the cattle in the county, and this practice will probably increase as more and more land comes into cultivation. Slaughtering and packing facilities established locally would be a great stimulus.

Local ranchers report that from 15 to 20 acres of pasture are required to support one animal unit consisting of a cow and calf. The improvements to the range, such as fencing and the increased number of watering places, no doubt allow a more complete use of the range, as the same area will support more cattle; although in periods of drought, when grazing and browse are scant, it is sometimes necessary to provide supplemental feed.

Improvement in the quality of cattle was delayed to a considerable extent by the prevalence of the cattle fever tick (*Boophilus annulatus*), which transmits the micro-organism causing the fever in cattle. The improved breeds are more susceptible than the old Longhorns. The tick was eradicated in the county 10 or 12 years ago, and since that time great improvements have been made in the quality of animals produced.

Comparatively few dairy cattle are kept. Three or four dairies in the vicinity of Eagle Pass supply the town, and some farms

in Quemado Valley produce cream for sale. One commercial dairy at Eagle Pass manufactures butter, ice-cream mix, and other milk products for sale in a territory that includes several adjoining counties. In 1929 the value of all dairy products sold was only $33,940 and the production of milk was only 136,473 gallons. The production of milk rose, however, to 217,188 gallons in 1934.

On January 1, 1935, according to the census, 20,697 cattle and calves of all ages were in Maverick County. This is a substantial increase over the 11,537 head reported April 1, 1930.

Prior to 1900 the sheep on the ranches were of American Merino breeding, but in the revived sheep-raising industry of the present the Rambouillet breed is favored (pl. 1, *B*). The Federal census records 108 head of sheep in the county in 1920, 24,723 in 1930, and 53,275 in 1935. Recent shipments have reduced the number. The value of the 161,990 pounds of wool clipped in 1929 was $42,117. The wool clip increased to 259,188 pounds in 1934.

Several flocks of Angora goats, raised primarily for the production of mohair, and a number of common or short-haired goats are in the county (pl. 1, *C*). The latter are maintained for local supplies of hides, milk, and meat. The 1935 census reports 10,237 head, including both breeds. The value of 20,225 pounds of mohair clipped in 1929 was $8,697. The mohair clip increased to 39,420 pounds in 1934.

The 1935 census reports 1,071 head of horses and colts of all ages, and 438 mules. Many of these were foaled in the county, but more were purchased outside. Most of the horses are cow ponies—small but sturdy and comparatively large-boned riding horses. The number of mules increased considerably in the period from 1930 to 1935, probably owing to the added number of irrigated farms on which mule power is used.

At present poultry (mostly chickens), bees, and swine are of only slight importance. These, with the exception of bees, which produce commercial honey, are raised for only local purposes. With the development of irrigation farming, swine and poultry may be expected to increase in numbers. Poland China is the favored breed of swine.

Table 2 gives the number of livestock on farms and ranches in Maverick County, as reported by the Federal census in stated years.

TABLE 2.—*Number of livestock on farms and ranches in Maverick County, Tex., in stated years*

Livestock	1880	1890	1900	1910	1920	1930	1935
Cattle	4,773	38,030	59,031	13,866	7,641	11,537	20,697
Sheep	111,240	149,310	14,070		108	24,723	53,257
Goats			10,095	1,259	2,722	8,228	10,237
Horses	878	1,737	1,118	909	183	183	1,071
Mules	57	620	203	244	206	84	438
Swine	274	404	146	218	741	147	294
All poultry	1,400	3,273	456	1,243	2,675	[1] 2,762	[1] 9,579
	Hives	*Hives*	*Hives*	*Hives*	*Hives*	*Hives*	*Hives*
Bees			1	5	102	264	

[1] Chickens only.

Few crops are grown, except on small areas in valleys along the Rio Grande and in scattered fields on ranches where feed crops are produced. The former are irrigated, but the latter are dry-farmed only when moisture conditions are favorable.

The production of corn, hay, and beans was reported as early as the census of 1880. These crops were grown on ranches for home use and had no commercial significance except so far as grain and forage crops were marketed through livestock. Additional feedstuffs for livestock on winter range are frequently needed, and such supplies are grown by ranchers under dry-farming methods in those years when the moisture supply is sufficient to promise a harvest. Under optimum conditions heavy yields are obtained, which, when properly stored, furnish all that is necessary for several seasons. In recent years drought-resistant grain sorghums, such a hegari, have replaced corn to a large extent. Most of the hay reported in the early census reports was made from native grasses.

Aside from feedstuffs, small acreages of beans, potatoes, sweetpotatoes, and cotton were reported in the census of 1890. These, with the exception of cotton, were for local consumption. Small acreages of cotton have been reported intermittently.

Soon after 1900 the first pumping plants were installed along the Rio Grande to furnish water for irrigation. These were privately owned and supplied water for some of the low benchlands adjacent to the vegas, or overflow bottoms. The first was established about 4 miles below Eagle Pass; a second, about the same distance above; and other plants were built from time to time, until many of the low benches and valleys along the river were irrigated in this manner. A larger publicly owned system furnishing water by gravity for the Quemado Valley was established in 1932. An extension of this system now reaches a point about 35 or 40 miles below Eagle Pass and includes all the low benchland formerly served by the privately owned plants and large areas of other land suitable for crop production.

With the provision of some irrigation, a wider variety of crops is reported. In the period 1909–1929, sorghums began to supplant corn for grain and forage; wheat and oats were grown on small acreages; and various orchard fruits, such as peaches, plums or prunes, and grapes, were reported. In the decade 1919–29 the acreage devoted to vegetables increased from 67 to 1,368 acres, and the shipment of winter vegetables became important. Commercial production of onions and, later, spinach largely accounted for this increase. Winter production of vegetables increased remarkably between 1930 and 1935, when the Quemado Valley was added to the available irrigable cropland of the county. This valley is a section of the Rio Grande Valley that lies about 12 miles north of Eagle Pass and includes about 15,300 acres. In 1932 and 1933, respectively, 435 and 1,047 carlots of spinach and 388 and 3 carlots of onions were shipped from the county.[8]

At present spinach and onions are the most important crops. They occupied the greater part of the 4,613 acres devoted to market vegetables in 1934, as reported by the Federal census. Other vegetables, including tomatoes, watermelons, cabbage, green beans, cantaloups, cauliflower, popcorn, and sweet corn, were grown on much smaller acreages. Among the staple crops, sweet and grain sorghums cut for silage, hay, and fodder led, yielding 3,670 tons from 943 acres. Grain sorghums cut for grain occupied 70 acres and yielded 2,745 bushels. Corn harvested for grain yielded 4,586 bushels from 262 acres. Alfalfa cut from 86 acres yielded 330 tons of hay. All other tame and wild

[8] GABBARD, L. P., and BONNEN, C. A. STATISTICS OF TEXAS AGRICULTURE. Tex. Agr. Expt. Sta. Cir. 80, 103 pp. 1937. See pp. 72–73.

grasses occupied 462 acres and yielded 627 tons of hay. Cotton on 128 acres produced 55 bales. From 110 acres, 957 bushels of dry beans were gathered. A small acreage of sweetpotatoes gave a fair yield, but potatoes yielded only 175 bushels from 11 acres. Sixteen acres were reported in strawberries, fruit orchards, vineyards, and planted nut trees. Grapefruit, oranges, and pecans are grown in the orchards.

Table 3, compiled from the Federal census, gives the acreage of the principal crops in stated years.

TABLE 3.—*Acreage of principal crops in Maverick County, Tex., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Cotton		4		15		115	128
Corn	685	1,479	100	101	1,337	243	262
Hay and forage	14	125	1,200	148	1,613	510	1,491
Grain sorghums					9	343	70
Dry beans					14	1	110
Potatoes and sweetpotatoes		6		7	2	1	24
Vegetables (excluding potatoes and sweetpotatoes) harvested for sale					67	1,368	4,613

In 1935, according to the Federal census, 92 percent of the total area of the county was in farms, averaging 1,601.7 acres each. These include numerous ranches that have no cropland and many farms that have no native pasture. In the more commonly accepted sense, the farms range in size from 5 to 2,000 acres, and the ranches occupy from 2,000 to more than 85,000 acres. Although 340 of the 460 farms included less than 30 acres, 98 percent of the land in farms is contained in 44 farms or ranches that are 1,000 acres or more in size and that average 16,416 acres. The general trend in average size of farms and ranches is downward, and this probably will continue. Some farms in the irrigated district now being developed are as small as 5 acres. These units are possibly too small for economical operation, and later they will probably be absorbed into larger ones.

Of the total area of the county, 14,951 acres, or 1.9 percent, was available for crops in 1934, as reported by the Federal census. This includes cropland harvested, land that failed to produce a crop, idle or fallow land, and plowable pasture. The total acreage of crops planted that year amounted to 7,778 acres. Crop failure occurred on 990 acres, leaving 6,788 acres from which crops were harvested. Irrigation was employed on 6,238 acres. The number of farms on which crops were harvested was 141, and the average acreage harvested per farm was 48 acres.

At present a very small amount of commercial fertilizer is used. Practically all of it is applied to the spinach and onion crops. A 6–10–7 [9] mixture is used by some farmers for spinach, and ammonium sulfate or ammonium nitrate is applied to onions as a side dressing. Spinach receives from 200 to 400 pounds an acre and onions 100 to 200 pounds. The census reports $7,101 spent for fertilizer in 1929, or an average of $645.55 for each of the 11 farms reporting its use. According to local information, the fertilizers produced profitable results.

[9] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Laborers, for which the demand is heavy during the spinach and onion harvests, are entirely Mexican, and the supply seems to be ample. The total wage bill reported in 1929 was $145,566, or an average of $3,732.46 for each of the 39 farms reporting.

Ranch and spinach and onion land rentals are on a cash basis. Since the development of the irrigated farms in the Quemado Valley, to which farmers from other sections of the State have been attracted, a number of third-and-fourth rental contracts have been in operation. Under these contracts the landlord furnishes the land and pays a share of the irrigation cost, in return receiving one-third of the cash crops and one-fourth of all others, or the cash value of these.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road and railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil [10] and its content of lime and salts are determined by simple tests.[11] Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare rocky mountainsides that have no true soil, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Uvalde, Monteola, and Laredo are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name

[10] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

[11] The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction. Lime (calcium carbonate) is detected by application of dilute hydrochloric acid.

of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Laredo silt loam, Laredo loam, and Laredo silty clay loam are soil types within the Laredo series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

The soils of Maverick County are representative of the soils and soil conditions occurring throughout a large section of the western part of the Rio Grande Plain. This is a section of generally fertile soils that are not largely used for cultivated crops on account of the inadequate supply of soil moisture, owing to a very light rainfall. Large areas of the soils are deep and have smoothly undulating or nearly flat surfaces whereon erosion is very slight. In comparatively small areas natural or geologic erosion has been severe, and the soils are thin, shallow, and low in inherent fertility.

Most of the soils are heavy and of clay or clay loam texture, although a few are sandy. The deeper soils contain considerable organic matter and are rather productive when their moisture supply is sufficient. Their consistence and structure usually allow ready cultivation when moisture conditions are favorable. They are suited to a considerable range of crops, although most of those of the uplands are too heavy to use for many vegetables and truck crops. A generalized soil map of the county is shown in figure 2.

The generalized soil map places the soils in six groups. The first group includes those soils of the Maverick series that are brown, have a heavy or moderately heavy texture, and occupy undulating lands. Monteola soils largely comprise the second group of soils, which are dark, have a heavy or moderately heavy texture, and occupy the smooth

uplands. Red friable sandy soils, largely of the Crystal and Webb series, make up the third group. The fourth group includes thin light-colored soils, largely of the Reagan, Zapata, and Maverick series, together with thin gravelly soils of the Reagan and Webb series. These soils generally are unsuited to cultivation. The fifth group includes soils of the alluvial flood plains of the Rio Grande Valley, largely Laredo soils and alluvial soils, undifferentiated. Soils of the alluvial flood plains and terraces of small stream valleys make up the sixth group. For the most part, these soils are members of the Leona and Uvalde series.

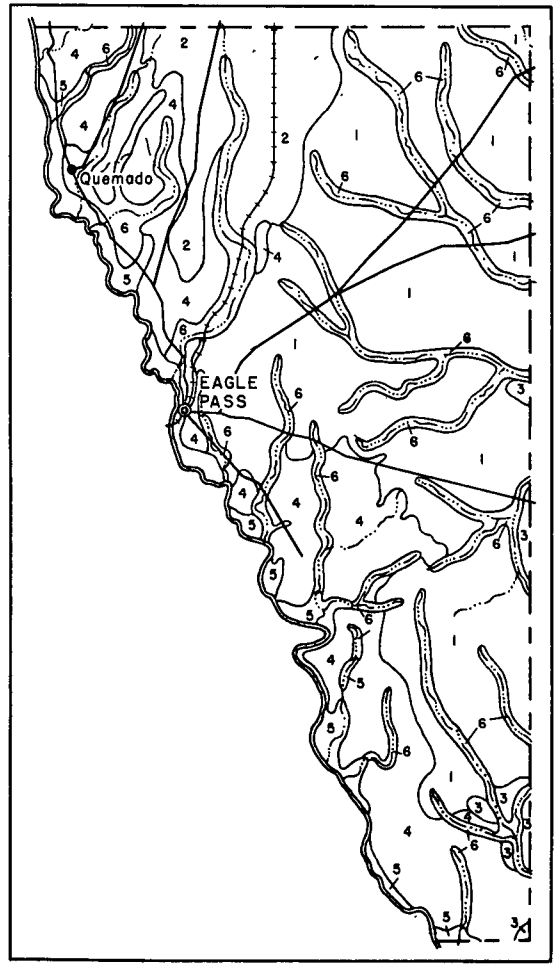

FIGURE 2.—Generalized soil map of Maverick County, Tex.: 1, Brown, largely moderately heavy textured or heavy-textured soils on undulating lands; 2, dark, largely moderately heavy textured or heavy-textured soils on smooth uplands; 3, red friable sandy soils; 4, thin light-colored or very gravelly soils; 5, soils of the alluvial flood plains in the Rio Grande Valley; 6, soils of alluvial flood plains and terraces of small stream valleys.

The soils are classified on the basis of soil characteristics into 10 series, 24 types, and 2 phases, in addition to the miscellaneous classifications of alluvial soils, undifferentiated, rough stony land, and rough broken land. The series represented are Laredo, Uvalde, Reagan, Monteola, Webb, Maverick, Crystal, Leona, Randall, and Zapata.

The Laredo series includes the light grayish-brown calcareous soils of the Rio Grande Valley. These soils occur on low terraces of old alluvium lying only a few feet above present ordinary overflows. They are permeable and low in organic matter but are well suited to the production of many crops, especially onions, under irrigation.

Soils of the Reagan series are medium or light brownish gray, crumbly or friable, and calcareous. They have developed from ancient beds of calcareous outwash consisting of clays, silts, sands, and gravel. The normal soils are deep and productive and have a well-defined layer of calcium carbonate accumulation.

The Zapata soils are very thin light-gray friable calcareous soils over chalky subsoils which consist mainly of slightly weathered parent materials. They are not deep enough for successful cultivation.

The Monteola soils are black or very dark grayish brown, heavy textured, and calcareous. They have developed on comparatively smooth surfaces from calcareous shales and clays. They have rather dense yellow clay subsoils but are very productive of certain crops when moisture conditions are favorable.

Alluvial soils, undifferentiated, include a number of soils that are not separated on the soil map. These are light grayish-brown calcareous soils of various silty and sandy materials deposited by overflow waters of the Rio Grande. They occupy the vega, or lowland adjacent to the river. They are subject to occasional inundation and, although potentially rather productive, are little used for cultivated crops.

The Webb soils are brown or dull reddish-brown noncalcareous soils with heavy or dense reddish-brown or red clay subsoils. Under the best moisture conditions they produce good grain and roughage crops without irrigation.

The members of the Maverick series are developed from beds of calcareous clay, shaly clay, sandy clay, and sandstone. The soils are grayish brown or yellowish brown and calcareous, with dense to moderately friable subsoils. In many places they are thin, immature, and not highly productive. On smooth surfaces, however, some of the normal soils produce fairly good yields.

The Crystal soils do not occur widely in the county. They are brown or dull reddish-brown noncalcareous soils developed from sandy materials of the Carrizo geological formation, which are mostly noncalcareous. They resemble the Webb soils but differ chiefly in their more permeable and friable subsoils. They have fairly good moisture-holding capacity and, when fertilized, are rather productive of certain crops.

Soils of the Leona series are black or very dark gray highly calcareous alluvial materials, mostly of heavy clay texture. They are not extensive.

The Randall soils are dark gray or black, generally noncalcareous, dense, and of clay texture. They occupy bottoms of shallow depressions, such as sinkholes or dry lake beds, and consist of fine soil materials washed from surrounding uplands.

Several systems of agriculture are developed in this county. These are ranching, combined ranching and livestock farming, commercial farming, and subsistence farming.

Ranching enterprises produce beef cattle, sheep, or goats on native pastures alone. These occupy approximately 94 percent of the land area of the county. The native cover of nutritious grasses, forbs,

and brushy browse, together with a mild climate, favor the low-cost production of range livestock. The lack of sufficient rainfall and, thus far, the absence of adequate sources of water for irrigation make the production of cultivated crops impossible on large areas of land, which will probably be used only for the grazing and browsing of range livestock for many years.

Combined ranching and livestock farming is of minor importance. It is engaged in on those ranches where native pasture is at times supplemented by feeds produced on tilled land. It is estimated that ranches where this practice is followed occupy only about 4 percent of the land of the county. The cropland thus used ranges from 20 to 500 acres per ranch. The land is dry-farmed, being sown largely to grain sorghums, Sudan grass, or other drought-resistant forage plants. Cropping takes place intermittently in seasons when the moisture supply seems to be sufficient and feed is needed to supplement that obtained from native pastures, but yields are uncertain, owing to the irregular rainfall. This does not constitute true livestock farming, as few of the animals are finished completely. The feed crops are for maintenance when native pastures fail rather than for production of fat livestock ready for slaughter. The soils used to produce feed under this system occupy both upland and valley positions, although most of them are on the upland. The soils thus used are chiefly fine sandy loams, clay loams, and clays of the Monteola, Uvalde, Webb, and Crystal series.

Commercial and subsistence farming systems may be considered together. The former is concerned with production of market produce on large acreages under irrigation. One or two vegetable crops are grown, as a rule, on rented land, and large tractor-drawn implements and cheap labor are employed. Rotations are seldom planned, and no livestock is produced or maintained. The subsistence system is characterized by irrigated farms of smaller size, most of which are owner-operated. Subsistence farmers practice a more diversified agriculture than do the commercial farmers, using many products at home and marketing the surplus when possible.

Under the gravity irrigation canal, an estimated 60,000 acres, or over 7 percent of the total area of the county, is available for the production of farm crops. The census reports that in 1934 crops were harvested from 6,283 acres of irrigated land in the county on 130 farms. This acreage probably is divided about equally between commercial and subsistence farms. Most of the farms are located on smooth-lying soils of the Laredo and Uvalde series and alluvial soils, undifferentiated, within the gravity irrigation system, but a small acreage on the Crystal, Webb, and Uvalde soils along the eastern boundary of the county is irrigated from wells drilled in the Carrizo formation, which outcrops here. Irrigated cropland outside these two limited areas may be expected to increase very slowly, owing to difficulties in obtaining water of suitable quality and quantity. Well water in most places is either unobtainable or too highly mineralized even for use by livestock. Certain small tracts possibly could be irrigated with rain water captured and stored in artificial reservoirs or

tanks such as those now used as watering places for livestock. Large areas of the normal or deep soils of both the uplands and valleys would be suitable and highly productive for tilled crops if water were available.

In order to present the relationships between soils and crops, the soils are grouped on the basis of their potential productivity and capability for use as follows: (1) Soils of high to moderate productive capacity, (2) soils of moderate to low productive capacity, and (3) miscellaneous soils and land types unsuited to cultivation. It should be understood that moderate or high production is possible only when sufficient water of satisfactory quality is applied.

The first group is further subdivided into (a) medium-textured soils, (b) light-textured soils, and (c) clay soils. The medium-textured soils of the group are Laredo silt loam; Laredo loam; Laredo silty clay loam; Uvalde silty clay loam; Uvalde silty clay loam, high phase; Reagan silty clay loam; Monteola clay loam; Reagan loam; and Reagan loam, colluvial phase. The light-textured soils in this group are Laredo very fine sandy loam; Laredo fine sandy loam; alluvial soils, undifferentiated; Webb fine sandy loam; Maverick fine sandy loam; and Crystal fine sandy loam. The clay soils of the group are Uvalde clay and Monteola clay.

The second group, which embraces soils of moderate to low productive capacity, also is subdivided texturally into (a) medium-textured soils—Maverick clay loam and Zapata silty clay loam, (b) sandy soils—Laredo loamy very fine sand, and (c) clay soils—Leona clay and Maverick clay.

Miscellaneous soils and land types include Zapata fine sandy loam, Zapata loam, Reagan gravelly loam, Webb gravelly fine sandy loam, Randall clay, rough stony land, and rough broken land.

In the following pages the soils of Maverick County and their agricultural relationships are described and discussed in detail, their distribution is shown on the accompanying soil map, and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Maverick County, Tex.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Laredo silt loam	3,264	0.4	Monteola clay	154,624	18.9
Laredo loam	3,072	.4	Maverick clay loam	71,360	8.7
Laredo silty clay loam	1,536	.2	Zapata silty clay loam	9,984	1.2
Uvalde silty clay loam	79,680	9.7	Laredo loamy very fine sand	3,392	.4
Uvalde silty clay loam, high phase	19,264	2.4	Leona clay	24,000	2.9
Reagan silty clay loam	20,672	2.5	Maverick clay	24,832	3.0
Monteola clay loam	129,216	15.8	Zapata fine sandy loam	11,648	1.4
Reagan loam	31,488	3.9	Zapata loam	16,640	2.0
Reagan loam, colluvial phase	37,504	4.6	Reagan gravelly loam	52,992	6.5
Laredo very fine sandy loam	8,384	1.0	Webb gravelly fine sandy loam	1,856	.2
Laredo fine sandy loam	1,216	.2	Randall clay	3,200	.4
Alluvial soils, undifferentiated	10,560	1.3	Rough stony land	2,240	.3
Webb fine sandy loam	12,992	1.6	Rough broken land	1,472	.2
Maverick fine sandy loam	5,760	.7			
Crystal fine sandy loam	10,304	1.3	Total	817,920	
Uvalde clay	64,768	7.9			

SOILS OF HIGH TO MODERATE PRODUCTIVE CAPACITY

The soils of high to moderate productive capacity are uniform in that they lie on smooth land and are comparatively deep. The group includes potentially good soils of both the valleys and uplands that are not used for cultivated crops because of lack of moisture, as well as those farmed under irrigation. Although the soils in these two positions are similiar in productivity and in certain profile characteristics, they present different problems of management, especially in irrigation and drainage, when used for the production of field crops. At present, most of the farming under irrigation is on the soils of the valleys, as irrigation and drainage of these soils are simpler than on the upland soils, although the latter make up by far the greater part of the group. The chief differences among soils of the group, aside from those that influence irrigability and drainage, are texture, color, and structure. These differences greatly affect the relative suitability of various members of the group for the production of certain crops and are specifically emphasized in the following discussion of the individual soil types.

MEDIUM-TEXTURED SOILS

Laredo silt loam.—To a depth ranging from 12 to 18 inches Laredo silt loam consists of grayish- or yellowish-brown calcareous silt loam. Practically the same material continues to a depth of 60 inches with little change except for a more intense yellow color, a very slight chalky accumulation, and, in places below a depth of about 18 inches, a silty clay loam texture. The laminations are thickest and most prominent near the top and become thin and faint in the lower part of the soil mass. When the soil is plowed it breaks into small angular easily crumbled clods.

As indicated by the color of the surface soil, this soil contains little organic matter, although it is well supplied with mineral plant nutrients. Under continuous cropping the addition of organic matter in some form possibly would be beneficial.

Laredo silt loam occurs on low terraces lying above overflow in the Rio Grande Valley, associated with other soils of the Laredo series. The greater part occurs in two general areas—one at Eagle Pass, the other near the mouth of Sauz Creek on the Indio ranch.

Despite its almost flat surface, both external and internal drainage of this soil is adequate. The generally deep parent material—exceeding a depth of 20 feet in most places—consist of alluvium deposited by the Rio Grande.

The native vegetation consists of a rather dense growth of medium- to large-sized mesquite trees, whitebrush, desert hackberry or granjeno, bluewood or brasil, Texas lotebush, soapbush or guayacan, and desertwillow, with a 10- to 15-percent cover of red grama.

About half of the soil is under irrigation and is used chiefly for the production of spinach (pl. 2, *A*), onions (pl. 2, *B*), sorghums (pl. 2, *C*), and corn. Spinach yields 350 to 700 bushels, onions 500 to 575 bushels, sorghums for dry fodder 8 tons, and corn 23 bushels

per acre. Sown and irrigated pastures provide approximately 210 cow-acre-days [12] of pasturage. Native pasture affords about 20 cow-acre-days.

Laredo loam.—Laredo loam, to a depth of about 15 inches, is brown or grayish-brown calcareous loam with a small-clod structure. The material crushes easily into finer aggregates. The texture becomes slightly heavier and the mass somewhat firmer in the lower part. This horizon grades into a transitional layer, 6 or 8 inches thick, of yellowish-brown calcareous silty clay loam, which, below a depth of about 2 feet, merges with yellow or brownish-yellow silty clay loam or clay containing many concretions or lumps of soft white calcium carbonate (lime). This reaches to a depth of more than 70 inches, and the amount of lime becomes less with depth.

This soil occurs in association with other Laredo soils on low terraces lying above overflow in the Rio Grande Valley and extends for some distance up the Indio Creek Valley in the southern part of the county. The total area of Laredo loam, as shown on the map, is not large. Between one-third and one-half of the soil is in cultivation under irrigation.

The surface is almost flat, having an imperceptible slope. The soil is developed on alluvial deposits of the Rio Grande, which are many feet thick. Both the soil and the parent material are easily penetrated by water and roots, and surface drainage is adequate.

The native vegetation consists of a 20- to 25-percent grass cover, chiefly red grama and three-awn, together with a scattered growth of moderate-sized mesquite trees, brasil, paloverde, and other shrubs.

Under irrigation this soil is used principally for the production of spinach, onions, sorghums, fall tomatoes, peppers, carrots, and other vegetables. It is especially valuable for growing vegetables, as it has desirable physical qualities that favor the growth of these crops. Methods of irrigation and management and crop yields are about the same as those on the other Laredo soils of finer texture.

Laredo silty clay loam.—Laredo silty clay loam is a brown calcareous silty clay loam which has a distinctly gray cast on drying. The surface soil is about 12 inches thick. The structure particles of the dry soil consist of medium-sized clods, although the surface material to a depth of 3 inches is thinly laminated. This grades into crumbly calcareous yellowish-brown silty clay loam or silty clay containing some fine dark-brown infiltrations of the surface material accumulated in cracks or root channels. Below a depth of about 30 inches the material is yellowish-brown calcareous silty clay, which becomes yellower with depth and includes some very small soft lime accumulations below a depth of 50 inches. The underlying parent material is alluvial in origin and very thick.

The soil is not extensive. It occupies slightly depressed situations on the low terraces, or benches, of the Rio Grande Valley, in association with other soils of the Laredo and Uvalde series. The largest area is in the southern part of the Quemado Valley in a broad depression through which extends an intermittent stream. This area is over-

[12] "Cow-acre-days" is a term used to express the carrying capacity of pasture land. As used here, it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture.

flowed for short periods during local rains. Other small areas occur in elongated swales on most of the low benches of the Rio Grande Valley. Drainage seems to be moderately free despite the depressed positions that the soil occupies.

Most of this soil is in cultivation, and it is managed and cropped in the same way as the soils with which it is associated. Where the native vegetation remains, it consists of a luxuriant growth of large mesquite and hackberry trees, brasil, granjeno, and dense thickets of whitebrush. In the open spaces, red grama and three-awn grow abundantly and cover from 5 to 10 percent of the surface. Under irrigation this soil is very productive, returning heavy yields of sorghums, corn, and Sudan grass hay. Sorghums yield 8 tons of forage, corn 30 bushels, and Sudan grass hay 4 to 8 tons per acre. Sown pasture, consisting of Sudan grass in summer and oats in winter, provides probably about 210 cow-acre-days of grazing, and native pasture about 15 cow-acre-days.

Uvalde silty clay loam.—The surface soil of Uvalde silty clay loam, to a depth of 12 inches, is brownish-gray calcareous silty clay loam. It contains moderate to fairly large quantities of organic matter and on drying separates into small soft clods. It is friable and crumbly and easily penetrated by plant roots. It contains a few small rounded igneous rocks. The subsoil, to a depth of 30 inches, is brown or yellowish-brown firm but crumbly calcareous silty clay. The yellow shade increases with depth, and below a depth of 30 inches the subsoil is brownish-yellow or grayish-yellow soft calcareous silty clay containing various quantities of soft lumps of calcium carbonate. The material below a depth of 30 inches is softer, more mealy, and less firm than that directly above. Brownish-yellow or yellow silty clay continues to a depth ranging from 10 to 20 feet, where, ordinarily, it rests on beds of rounded gravel.

As a rule, lumps and concretions of lime are concentrated in a layer between depths of 30 inches and 5 feet. No definite or sharp delineation marks the different horizons of the profile, but each merges gradually with the horizon above or below.

The soil is fairly uniform, varying only slightly from place to place in content of organic matter and in texture. A few very small saline spots in some of the creek valleys, notably Indio, Rosita, and Sauz, show the effect of alkali or salt concentration. Such areas commonly are referred to as "slick spots." They are characterized by the absence or a stunted growth of vegetation, with attendant sheet erosion and gullying. The surface soil of such spots is grayer than that of the normal soil and, at a depth of 8 or 10 inches, rests on a hardened 6- to 10-inch layer of small cubical block structure, under which the normal soil profile prevails. Such a spot along Indio Creek is indicated on the map by symbol.

The land occupied by this soil is extremely smooth and very gently sloping. The parent materials are calcareous old alluvial sediments that originated in the Edwards Plateau and local uplands. Drainage, both external and internal, is excellent.

The native vegetation consists of a 25- to 30-percent cover of red grama, curly mesquite, and three-awn, with a scattered to moderately dense growth of large-sized mesquite trees, granjeno, brasil,

Texas lotebush, guayacan, catclaw or huisachillo, pricklypear, tasajillo, and Spanish-dagger.

Less than 9 percent of this soil is in cultivation, and this is all under irrigation. The remainder is used for livestock range. Most of the cultivated area is devoted to the production of sorghums for feed, but some is used for growing winter truck crops, chiefly spinach, onions, tomatoes, carrots, cabbage, and peppers. All these crops yield well under irrigation without the aid of other soil amendments. Sorghums yield 5 or 6 tons of dry forage per acre in two cuttings a year (pl. 2, *C*), spinach about 325 bushels, onions 150 to 300 bushels, fall tomatoes 3 tons, carrots 8 tons, cabbage 10 tons, and other vegetables in proportion.

Row crops are irrigated by the furrow method; but broadcast crops, such as spinach, are irrigated by the border method. No special systems of rotation or management are employed. Both teams and tractors furnish power for the preparation of seedbeds. Most of the irrigation water flows by gravity from the Rio Grande, and a very small acreage near the eastern border of the county is irrigated from wells.

This soil furnishes a fairly good growth of native plants for grazing and browse, providing approximately 20 cow-acre-days. Sown pasture provides about 210 cow-acre-days.

Uvalde silty clay loam, high phase.—The 12-inch surface soil of Uvalde silty clay loam, high phase, consists of dark brownish-gray calcareous silty clay loam. On drying the mass breaks into small angular clods that crush easily. Some granulation is evident in the topmost 5 inches, or grass-root zone, and in places where undisturbed, the upper surface soil has a fine laminated structure. The subsoil is brownish-gray calcareous silty clay loam or silty clay, which is rather friable and crumbly and reaches to a depth ranging from 24 to 30 inches. Here is the zone of chalky calcium carbonate accumulation, which extends to a depth of 85 inches in places. This material consists of light brownish-gray or brownish-yellow silty clay loam or silty clay filled with much fine chalky material. In many places the upper 6 inches of this layer consists of broken fragments of hardened platy caliche interbedded with soil. Indications are that the underlying formation, at least in places, consists of gravel beds many feet thick.

This soil is rather uniform, and variations are slight. Roots penetrate the soil mass to a great depth, and the soil does not contain an excess of salts or alkali. It occupies high smooth areas in association with the Reagan soils and occurs in several moderately large bodies. The surface is flat or very gently sloping. The parent material from which the soil has developed is of ancient plains outwash, probably mostly from formations of the Edwards Plateau. Internal and external drainage are excellent.

Grass covers from 25 to 40 percent of the surface and consists largely of curly mesquite, red grama, and three-awn. The remaining cover is a rather scattered growth of medium- to large-sized mesquite trees and a brushy growth, mostly of guajillo, granjeno, brasil, lotebush, guayacan, catclaw, and paloverde.

None of this soil is in cultivation. Its native cover provides grazing for approximately 21 cow-acre-days. The chief disadvantage for the use of this soil in the production of cultivated crops is its high elevation above all present sources of irrigation water. The soil itself, however, would be well suited to the production of many kinds of crops under irrigation and probably would equal typical Uvalde silty clay loam in crop adaptation and productivity.

Reagan silty clay loam.—The surface soil of Reagan silty clay loam is light brownish-gray calcareous silty clay loam. The dry soil has a small-clod structure. The topmost 4-inch layer is darker and slightly more granular than the material below. Below a depth of 12 inches the subsoil is yellowish-brown calcareous silty clay loam or silty clay containing some small rounded gravel and a few lumps of soft white calcium carbonate. In places, at a depth of about 24 inches, this rests on hardened caliche and bedded gravel, indicating a parent material of old outwash-plains materials, but in places it rests directly on sandstones and shales.

This soil occurs in a few fairly large bodies on the eastern edge of the ancient outwash terraces, and a few smaller areas are in the vicinity of Eagle Pass. The areas are smooth, flat, gently sloping, or undulating. Drainage, both internal and external, is excellent.

The native vegetation consists of a 25- to 40-percent grass cover, mainly red grama, curly mesquite, and three-awn. There are small areas densely covered with tobosa grass, and a scattered moderate-sized brushy growth of catclaw, mesquite trees, cenizo, huisachillo, huajillo, granjeno, brasil, blackbrush, creosotebush, goatbush or amargosa, and others.

None of this soil is in cultivation, as it is not situated in positions to allow the application of irrigation water from the present sources. This soil is probably fertile and under irrigation probably would have about equal productivity and similar crop adaptations to those of Uvalde silty clay loam.

Monteola clay loam.—The 7- to 12-inch surface soil of Monteola clay loam is dark grayish-brown or nearly black calcareous friable and somewhat granular clay loam. It merges with the dark grayish-brown calcareous heavy compact clay subsoil, which, on drying, becomes hard and tough, separating into large and small slick angular clods, but the material seems to be rather permeable to water. At a depth ranging from 16 to 26 inches this grades into heavy compact yellowish-brown calcareous clay containing a few small soft lumps of calcium carbonate, and this continues downward into rather friable grayish-yellow calcareous sandy clay containing various quantities of soft white calcium carbonate. This is the layer of lime accumulation. Below a depth of 4 feet the material is yellcwer, of sandy clay or clay texture, and contains fragments of disintegrated sandstone, shale, or oystershells. In some places the clay parent material contains quantities of soft crystalline gypsum.

This soil occurs in large and small bodies on high smooth nearly flat areas throughout the uplands of the county. It is the second most extensive soil in the county, occupying a total of 201.9 square miles and being surpassed in area only by Monteola clay. The parent

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material from which it has developed consists of calcareous and noncalcareous shales, sandstones, and clays of the Upper Cretaceous, and possibly some of the Tertiary, period. External drainage is free, but internal drainage is slow, owing to the heavy character of the subsoil and the parent materials.

The native vegetation consists of a 20- to 30-percent grass cover, chiefly red grama, and small quantities of three-awn, curly mesquite, and tobosa grasses, with a more or less scattered growth of medium-sized mesquite trees, huisachillo, blackbrush, catclaw, pricklypear, and tasajillo.

Only a small acreage of this soil is devoted to tilled crops in this county, and none of it is irrigated. Probably from 50 to 100 acres of the soil is dry-farmed in association with cultivated areas of Monteola clay. The only crops produced are sorghums and Sudan grass. The sorghums are mainly hegari (a grain sorghum) and Sumac (Red Top) sorgo. When moisture conditions are favorable, heavy yields are obtained. Yields of 2 tons of sorghum forage are obtained under dry-farming conditions, and 5 or 6 tons might possibly be produced under irrigation. Sudan grass is usually grazed.

Cropping such as this occurs on ranches where auxiliary feed is desired to supplement the native forage. As a rule, the fields are not cropped every year but only in seasons when the moisture supply is sufficient to insure a crop and when additional feed is needed. Well water is not available for irrigation of this soil, but some favorably situated fields might be irrigated by means of earth storage tank reservoirs similar to those now used for watering livestock.

Reagan loam.—The surface soil of Reagan loam consists of light brownish-gray or yellowish-brown calcareous loam, about 10 inches thick, which is rather gray when thoroughly dry. The dry soil breaks freely into small easily crushed angular clods. In many places the soil contains a few hardened chalky particles. It grades into light grayish-brown or pale yellowish-brown calcareous silt loam, silty clay loam, or clay loam, which reaches to a depth ranging from 3 to 6 feet, where it rests on beds of hardened caliche or rounded gravel. At various depths in the soil material are a few lenses and fragments of platy caliche, and in the lower part are numerous soft chalky lumps of calcium carbonate.

This soil occupies smooth, gently undulating, or sloping positions on the ancient outwash plain, high above the Rio Grande Valley, in association with the soils of the Reagan, Uvalde, and Zapata series. It occurs in large and small bodies, chiefly in the western third of the county. A few small areas, isolated from the main bodies, are near the Maverick-Dimmit County line on the Glass ranch and elsewhere in the eastern two-thirds of the county. The total area is fairly large.

The native vegetation consists chiefly of cenizo, guajillo, white-brush, *Coldenia canescens*, cudweed, paloverde, brasil, small mesquite, catclaw, and creosotebush. Although not so abundant as on other soils, cenizo and guajillo are common. The grasses are mainly red grama and three-awn, comprising 15 to 20 percent of the cover. About 20 cow-acre-days of grazing and browse are afforded by the native vegetation.

None of this soil is cultivated. Under irrigation it should be fairly productive and suited to crops and management similar to those on soils of the Laredo and Uvalde series, but most areas are too high above the Rio Grande to be irrigated from local sources of water in that stream.

Reagan loam, colluvial phase.—The surface soil of Reagan loam, colluvial phase, is brownish-gray calcareous loam about 10 inches thick. It merges with grayish-brown or yellowish-brown crumbly calcareous somewhat compact silty clay loam or silty clay. Below a depth of 20 to 30 inches the subsoil is brownish-yellow silty clay loam or silty clay containing soft lumps of white calcium carbonate. At a depth of about 36 inches this rests on a bed of rounded gravel of chert, limestone, and igneous rock. Thin layers of bedded gravel occur in places higher in the profile, and some gravel is cemented with hardened caliche. In places no calcium carbonate has accumulated. Some very small areas of Reagan gravelly loam are included with this soil on the map.

This is a fanlike outwash of soil and gravelly material from higher areas of Reagan gravelly loam. Long gentle slopes extend from the base of the gravel ridges for some distance into the lower valleys. The soil also occurs in the narrow valleys within the gravel ridge area. A fairly large total area is mapped.

The relief is gently to moderately sloping. The parent material is colluvial from ancient outwash terraces. Surface drainage is rapid, and in some places the land is cut by gullies. Interior drainage is normal.

The native vegetation consists of a 20- to 25-percent cover of red grama, three-awn, curly mesquite, and pappusgrass, with scattered brushy clumps of large mesquite trees, guayacan, *Coldenia canescens*, cudweed, paloverde, pricklypear, and Spanish-dagger.

Only a very small part of the soil is in cultivation, and most of this is in the Quemado Valley, in the vicinity of Hopedale and Indio ranch, and between Rosita and Sauz Creeks. The cultivated area does not exceed 3 square miles. The soil is productive, and with the expansion of irrigation it is possible that much more of it will be used for tilled crops. The crops produced are sorghums, corn, spinach, onions, and other winter vegetables. The yields approximate those on the better Laredo soils.

Because of the sloping relief of this soil, irrigation may be more difficult than on some of the more nearly level valley land. In some places terraces may be necessary to prevent erosion after the land is cleared. The open character of this soil causes it to be especially subject to waterlogging under irrigation. Where open canals traverse the areas, they should be lined, in order to prevent seepage.

LIGHT-TEXTURED SOILS

Laredo very fine sandy loam.—The surface soil of Laredo very fine sandy loam is grayish-brown calcareous rather friable very fine sandy loam ranging from 10 to 18 inches in thickness. It becomes slightly finer textured, more compact, and lighter colored in the lower part. This material merges, through a short transitional layer, into

light brownish-yellow heavy very fine sandy loam or clay loam, which also is calcareous and contains traces of free calcium carbonate in the form of soft white lumps. The material shows no significant change to a depth of several feet and rests on gravel beds many feet beneath the surface. This soil is uniform, except for slight variations in thickness of the several layers.

This soil occupies areas on the low smooth terrace benches in the Rio Grande Valley, which are now above normal overflow. The parent material from which the soil is developed is composed of alluvial sediments deposited by the Rio Grande. The permeable character of the soil and parent material provides excellent internal drainage. Although the surface is smooth and nearly flat, in most places the slope is sufficient for adequate surface drainage. Under present methods of irrigation, by unlined canals and lateral ditches, the porous character of both the surface soil and the subsoil results in seepage and the formation of a high water table in many places.

The native vegetation consists of a 40- to 45-percent grass cover, largely red grama and three-awn, with a scattered growth of large-sized mesquite trees and shrubs of brasil, granjeno, huisachillo, and whitebrush.

Although not so extensive as some of the other soils in the group, it is one of the most important soils because of the large proportion—about 75 percent—of the total acreage used for the production of irrigated crops. It is widely used for the production of spinach and onions. Spinach is reported to yield from 300 to 350 bushels and onions as high as 500 bushels an acre when grown under the same conditions. According to local information, tomatoes yield from 4 to 5 tons an acre, carrots 15 to 18 tons, and cabbage 5 to 8 tons. Most vegetables and fruits suited to the region succeed well on this soil, but broccoli, cabbage, and other crucifers are reported as giving higher yields on the darker and heavier soils that are irrigated. Management of the soil is similar to that for all soils of the county under irrigation. Green manures might prove beneficial.

In places Laredo very fine sandy loam occupies narrow depressed areas on benches of the Rio Grande Valley in close association with areas of the typical soil. Here the soil is slightly darker than elsewhere, owing to a heavier cover of vegetation and the resulting increased amount of organic matter. Because of its depressed position, the soil receives more water than higher areas. These low areas cover a total of less than 1 square mile. They are cultivated in association with the typical soil and, where waterlogging has not taken place, give similar or slightly greater yields. Owing to the low position, seepage and a high water table occur in the soil of these areas sooner than in other places.

Laredo fine sandy loam.—The 10- to 15-inch surface soil of Laredo fine sandy loam is grayish-brown calcareous fine sandy loam. It grades into yellowish-brown calcareous fine sandy loam or fine sandy clay loam, which reaches a depth of several feet. This soil, like others of the Laredo series, comprises the surface layers of ancient alluvium in beds 30 or more feet thick.

This soil is similar to Laredo very fine sandy loam in all soil characteristics except texture. It occupies slightly higher or more sloping

positions and therefore is less subject to waterlogging under irrigation. The two soils support about the same native vegetation. The largest single area, at Quemado, is all in cultivation. Methods of cultivation, crops grown, and yields are practically the same on the two soils.

Alluvial soils, undifferentiated.—Alluvial soils, undifferentiated, consist of small areas of soils too intricately intermingled to separate on a small-scale map. These soils consist chiefly of light-textured soils of the Rio Grande series. They are Rio Grande loamy very fine sand, Rio Grande very fine sandy loam, and Rio Grande silt loam, together with some spots of riverwash. These soils are not uniform in texture and are not representative of the typical soils of the Rio Grande series. The uneven surface is marked by low mounds and intervening sloughs that parallel the river. In some places sand bars and gravel beds, deposited in recent overflows, are included in this designation. If their area were larger they would be indicated as riverwash.

These soils occupy the very low first bottom alluvial flood plain of the Rio Grande, locally called vega. The vega lies only a few feet above the river and is overflowed occasionally. Most of it is covered with a dense growth of giant reed or carrizo, *Aster spinosus*, desert-willow, common willow, an occasional hackberry, pecan, and, in some places, large mesquite trees. Open places support a lush carpet of Bermuda grass.

A few areas of this land, which are sufficiently smooth, are cleared and cropped. Two or three of these areas are irrigated and planted to spinach; and several others, not irrigated, are sown to Sumac (Red Top) sorgo and Johnson grass, which are cut for hay or grazed, and excellent yields are reported. Most of the soils of the vega are of such light texture and uneven surface that they are useless for cultivation. They probably furnish the best natural grazing and browse in the county, providing about 30 cow-acre-days of grazing.

Webb fine sandy loam.—The surface soil of Webb fine sandy loam is brown or reddish-brown noncalcareous fine sandy loam, 10 to 15 inches thick. To a depth of 4 inches the material is darker than that beneath, and a red tinge is more prominent in the lower part. The upper part of the horizon is also less compact than the lower, but the material throughout is friable. The structure may be described as fine granular, although the soil mass is somewhat coherent and has a tendency toward cloddiness. The upper part of the subsoil consists of a transitional layer, about 10 inches thick, of compact and less friable reddish-brown fine sandy clay loam with infiltrations of brownish red noticeable in old worm tunnels and root passages. Below the transitional layer is dark brownish-red fine sandy clay loam or heavy fine sandy clay, which is plastic when wet and rather hard when dry. The material in this horizon is fairly compact. In a few places it is calcareous, but generally it is not. In places the horizon contains a few small lumps of calcium carbonate in the lower part. At a depth ranging from 3 to 5 feet the material is light reddish-yellow or light-gray chalky fine sandy clay loam or fine sandy clay containing soft white lumps of calcium carbonate. This is the horizon of accumulation. At a depth ranging from 48 to 84 inches, this rests on soft sandstone, which is yellow or gray and may or may

not be calcareous. In places particles of chert gravel, few of which exceed one-half inch in diameter, occur throughout the soil mass.

In many places the transitional layer underlying the surface soil is very thin or entirely absent. This is also true of the layer of lime accumulation. In places the disintegrated sandstone from which the soil has developed lies much nearer the surface but nowhere near enough to result in a shallow phase of the soil.

One or two very small areas, where the surface is slightly depressed or eroded, are occupied by Webb clay loam, but the total area is too small to warrant separation on the map. This soil is similar to Webb fine sandy loam except in texture of the surface soil. Also, a very small area of a soil resembling San Antonio clay loam is included in mapping. This inclusion is near Chapotol Hill. It consists of a layer of dark grayish-brown or almost black calcareous clay loam, about 10 inches thick, which overlies the normal red sandy clay or clay subsoil similar to that of soils of the Webb series.

Webb fine sandy loam occurs in both small and fairly large bodies in association with Crystal fine sandy loam, along the eastern edge of the county. It generally occurs at lower elevations than the Crystal soils and occupies smoother land. The sandstones from which it has developed probably are largely of Tertiary age. Although the land is level to gently undulating and the subsoil is rather dense, drainage has not become a serious problem where the soil is irrigated from wells. Poor drainage might develop if large heads of water remained in unlined canals and laterals, as seepage probably would occur, the heavy subsoil might not allow adequate underdrainage, and a high water table might develop. The total area is fairly large.

The native vegetation consists chiefly of a dense growth of blackbrush mesquite trees, huisachillo, brasil, guayacan, granjeno, desert yaupon, amargosa, paloverde, leatherweed or sangre de drago, and a 30- to 40-percent grass cover, mainly red grama, three-awn, crowfoot, and pappusgrass, and some curly mesquite.

A total area not exceeding 100 acres of this soil is in cultivation, and the greater part of this is dry-farmed in the production of forage, mostly sorghums. A small acreage is irrigated for spinach and onions on one farm near Palo Blanco Creek 1 mile south of Rambio ranch on the Maverick-Zavala County line. Under dry-farming conditions hegari is reported to have yielded well. Spinach under irrigation yields from 200 to 250 bushels an acre. Increases in yields are reported on this soil under irrigation and with the application of commercial fertilizers and the use of such green-manure crops as cowpeas. As a rule, yields are higher than those obtained on either Maverick fine sandy loam or Crystal fine sandy loam. This soil, although supporting an abundance and a wide variety of native browse plants and a fair grass cover, is said to be not quite so valuable for grazing as Crystal fine sandy loam or Maverick fine sandy loam. It furnishes approximately 20 cow-acre-days of grazing. A considerable cover of coarse bunchgrasses and three-awn grasses grows on much of this soil. Blackbrush is an abundant shrub, and small mesquite and huisache trees grow in scattered patches, with an association of various shrubs common to the region.

Maverick fine sandy loam.—The surface soil of Maverick fine sandy loam consists of grayish-brown or yellowish-brown calcareous fine sandy loam, about 12 inches thick, which is slightly coherent but separates into clods when disturbed. It grades into brownish-yellow calcareous fine sandy clay loam, which, below a depth of about 24 inches, passes into friable light-yellow or gray calcareous fine sandy loam or calcareous fine sandy clay, which contains accumulated lime in soft white lumps. The thickness of this horizon ranges from 1 to 3 feet, reaching a depth ranging from 40 to 60 inches. Below this, soft calcareous yellow or gray sandstone, grayish-yellow very fine sandy clay, or silty clay are reached. The sandstone in many places is covered with a thin crust of hardened white caliche.

A few very small areas of Crystal fine sandy loam are included with mapped areas of this soil. Where these two soils occur in close association, the small areas are not separated on the map. For the same reason, small areas of Maverick fine sandy loam may be included in areas mapped as Crystal fine sandy loam.

Maverick fine sandy loam occupies moderately large and many small bodies throughout the eastern and central parts of the county, although the total area is not large. The soil occurs mainly in the vicinity of sandstone outcrops, generally adjacent to Zapata fine sandy loam which immediately surrounds the outcrop. The topographic location of this soil is on hilltops, hill shoulders, and in a few places along the bases of hills, but in few places does it extend far from a rock outcrop. In places the rock does not actually outcrop, but the soil indicates that sandstone is not far below the surface.

Internal and external drainage are adequate. Erosion is not serious, although under cultivation to intertilled crops some serious erosion might occur.

The native vegetation consists of moderately large mesquite trees, brasil, granjeno, huisachillo, Texas lotebush, blackbrush, *Coldenia canescens*, cudweed, guajillo, guayacan, paloverde, and pricklypear. The 25- to 30-percent grass cover consists mainly of red grama and three-awn with some pappusgrass.

None of the soil in this county is tilled, but just east of this county, in Zavala and Dimmit Counties, some is cultivated, both under irrigation and by dry farming. Crop yields in those counties are reported as being slightly higher than those on Crystal fine sandy loam and slightly less than those on Webb fine sandy loam. Under irrigation the soil is used chiefly for spinach, onions, peppers, and other winter vegetables. In dry farming, corn, sorghums, and Sudan grass are the main crops. Spinach normally yields 225 bushels, onions 200 bushels, and irrigated corn 26 bushels an acre. Corn grown in dry farming is said to yield about 13 bushels and sorghums 3 tons an acre. About 5 or 6 tons of dry sorghum forage an acre is reported to have been produced under irrigation. Under irrigation, yields can possibly be increased materially by the use of commercial fertilizers, green-manure crops, and, on some areas, by terracing to prevent erosion and loss of water.

Crystal fine sandy loam.—To a depth ranging from 12 to 16 inches, the surface soil of Crystal fine sandy loam is reddish-brown

noncalcareous fine sandy loam that is slightly coherent when wet and has a tendency to become crusted on drying. As a rule, the topmost 4 or 6 inches is darker colored than the material beneath and the lower part is redder and lighter colored. The surface soil merges with brownish-red fine sandy clay loam, which, below a depth of about 30 inches, passes into light yellowish-red or reddish-yellow fine sandy loam. This is faintly calcareous and includes some soft white lumps of calcium carbonate in the lower part. At a depth of 50 inches and continuing to a depth of 7 feet, the material is light grayish-yellow fine sandy loam, which is friable and contains considerable accumulated calcium carbonate in soft lumps or spots. The soil has much the same color characteristics as Webb fine sandy loam, but the layers are more friable and more permeable.

As mapped, this soil includes a few small areas of a shallow phase of Crystal fine sandy loam. This differs from the typical soil in that sandstone lies only 4 to 15 inches below the surface. The shallow soil occurs in a very few places around sandstone outcrops, mostly of the Carrizo formation.

An area of Crystal loamy fine sand, 1 mile west of the Maverick-Zavala County line and 7 miles north of the highway between Eagle Pass and Carrizo Springs, is also included in mapping. Less than one-fourth square mile of this soil is in the county. To a depth ranging from 3 to 5 feet, it consists of dull reddish-brown loamy fine sand, which is noncalcareous and has a single-grain structure. This is underlain by gray sandy clay mottled with red and yellow. The clay is sticky when wet and faintly calcareous in places. In other places the loamy fine sand surface soil rests directly on red, yellow, or gray sandstone, most of which is not calcareous.

Some very small areas of Maverick fine sandy loam are also included with this soil. These areas are too small to show on a small-scale map.

Areas of Crystal fine sandy loam, with one or two exceptions, occur along the eastern border of the county. A fairly large total area is mapped.

The surface of this soil is more sloping and the elevation generally is slightly higher, compared with those features of Webb fine sandy loam. The parent material is soft sandstone, most of which probably belongs to the Carrizo formation. In some places this material is calcareous. Internal and external drainage are good.

The native vegetation consists of a scattered but large-sized growth of mesquite trees, brasil, granjeno, hog-plum, paloverde, lantana, verbena, leatherweed, various mallows, and other small flowering plants. The grass cover occupies about 40 to 45 percent of the land and consists largely of three-awn, sandbur, crowfoot, and hairy grama.

A small acreage of this soil in the northeastern part of the county is cultivated, mostly without irrigation, although a small area is irrigated. The cultivated land is used largely for the production of feed crops. Under irrigation it has produced spinach and onions. Yields are similar to or slightly less than those obtained on Maverick fine sandy loam. The soil responds readily to the use of commercial fertilizers or green-manure crops. In some places terracing to guard against erosion may be considered necessary.

The soil affords excellent native grazing, especially in spring and during droughts, and is estimated to provide about 22 cow-acre-days of grazing.

CLAY SOILS

The two clay soils in the group of soils of high to moderate productive capacity—Uvalde clay and Monteola clay—are among the most extensive soils in the county. They contain comparatively large quantities of organic matter in their surface layers and are very dark gray or almost black. In seasons of adequate moisture these soils produce an abundance of nutritious grazing, but, because of their dense physical character, vegetation on them suffers quickly in seasons of drought. This characteristic, together with the limited variety of browse plants that they support, lowers their average grazing capacities. Under cultivation, when moisture conditions are favorable, yields are good. They are best suited to the production of forage crops and other staple crops and are also suited to some vegetables, such as cabbage, broccoli, and others of this kind.

Uvalde clay.—The 10-inch surface soil of typical Uvalde clay consists of very dark gray or brownish-gray calcareous clay, which is almost black when moist. It is crumbly, breaking when dry into small hard angular clods. In most places the topmost 4-inch layer is somewhat granular, and the lower part is more dense and compact, having perpendicular cracks that give a prismatic structure. The depth of this layer is variable, however, being deepest in the smaller areas along small creeks and upland drains. The color is darkest where the soil is deepest. In places the soil is practically the same to a depth of 2 feet or more. The surface soil grades into brownish-gray calcareous silty clay or clay that is crumbly but breaks into larger clods. This layer ranges from 20 to 30 inches in thickness and merges, at a depth of about 4 feet, with yellowish-gray or grayish-yellow calcareous clay containing soft lumps of calcium carbonate. The clay becomes yellower with depth, and the white accumulations of calcium carbonate disappear below a depth of 72 inches. In places particles of crystalline gypsum occur in the lower part of the subsoil but not so abundantly or so uniformly as in the subsoils of the Monteola and Maverick soils.

This soil in places has so-called hog wallows on the surface, but they are not so numerous or so prominent as on Monteola clay and Monteola clay loam. These hog wallows are slightly depressed areas, ranging from 10 to 25 feet in diameter, in which the soil is blacker and not so calcareous as the material surrounding them.

This soil occurs on benches of old valley-filling material in both the larger and smaller valleys of the county. It occupies some fairly large areas in the larger creek valleys and along the upland side of the Quemado Valley. Much of this soil lies under the main canal of the gravity irrigation district, but a large part of it occupies narrow bands along upland drainageways. Probably from 3 to 4 square miles of this soil is now under cultivation in the irrigated district, and probably an equal area is available for irrigation under the gravity canal. The total area in the county amounts to 101.2 square miles.

The surface is very smooth in most places, especially in the larger areas, but it has sufficient slope for irrigation and drainage. In some of the smaller stream valleys the soil is cut by channels and sloughs at frequent intervals, and in such locations it is not very desirable for cultivation. It is developed on stream sediments and colluvium that have originated largely in the local uplands, although some of the material doubtless originated in the Edwards Plateau or in the ancient outwash plains. Surface drainage in most places is fairly free; and, although internal drainage is slow, the heavy surface soil and subsoil are sufficiently permeable to allow water to pass downward. Drainage, however, is not so rapid, and therefore the seepage of irrigation water from unlined canals is not so free, as in some of the coarser soils.

The native vegetation consists of a dense growth of small to moderately large mesquite trees, whitebrush, brasil, pricklypear, tasajillo, and catclaw. From 30 to 40 percent of the land supports a grass cover consisting largely of curly mesquite, buffalo grass, tobosa, and red grama. In seasons of favorable moisture conditions this cover affords excellent grazing, but in dry periods the carrying capacity is low. An average of about 20 cow-acre-days of grazing is provided.

None of the soil is dry-farmed. Under irrigation the forage crops, mainly sorghums and Sudan grass, are most important. Some spinach and onions are grown, and heavy yields are reported, but the quality of onions is said to be somewhat lower than of those produced on coarser soils. The lower leaves of spinach at times tend to turn yellow, and the onions do not mature into uniformly perfect specimens. Cabbage, broccoli, beets, carrots, and radishes produce large yields. It is reported that root crops are not of such good quality as those grown on lighter soils. Alfalfa has been grown with some success, but it is injuriously affected by cotton root rot. Cotton produces a large stalk but does not always fruit well and is also subject to severe injury from root rot.

Monteola clay.—Monteola clay consists of very dark brownish-gray or almost black calcareous clay to a depth ranging from 12 to 30 inches. It is crumbly when moist, is very sticky when wet, and breaks into small hard angular clods when dry. The topmost few inches are somewhat granular, and below a prismatic breakage in the dry material is apparent. The surface soil grades into grayish-brown or dark-gray calcareous clay, ranging from 10 to 30 inches in thickness, which in turn, grades into yellow, grayish-yellow, or gray soft calcareous clay that is not so heavy or compact as the material above and contains various quantities of soft lumps of calcium carbonate and crystals of gypsum. Generally calcium carbonate is concentrated above the gypsum zone, but in places it is absent.

The surface of this soil is pitted with slightly depressed areas, or hog wallows, ranging from 10 to 15 feet in width. In some places they occupy fully 50 percent of the land surface. The soil in the hog wallows is darker than that on the higher areas between them and generally is somewhat less calcareous.

This soil occupies large and small bodies on smooth almost flat to gently sloping land throughout the broader central upland divides. It is the most extensive soil in the county and covers approximately 241.6 square miles. It is developed on material from deeply weathered calcareous shales and clays of Upper Cretaceous and

Tertiary ages. Surface drainage is adequate except in one or two large bodies in the northern part of the county, where the land is so flat that run-off is slight. Several large shallow lake beds, locally known as lagunas, receive some drainage from nearby areas, but even on these large uniform areas there is no indication of poor drainage.

The native vegetation consists of a dense to moderate growth of mesquite trees and shrubs of medium size, with a 35- to 50-percent cover of grass, chiefly curly mesquite and tobosa. The shrubs are chiefly pricklypear, tasajillo, huisachillo, granjeno, brasil, guayacan, blackbrush, leatherweed, and Texas lotebush. Some areas support a dense grass cover, with few woody plants. This soil provides extensive grazing when moisture conditions are favorable, but in dry seasons grass becomes burned. The soil provides an average of 20 cow-acre-days of grazing under all conditions.

Most of this soil is in native pasture, and probably not over 300 acres are cultivated. The land in cultivation is on ranches where it is used mainly for the production of auxiliary forage and grain crops consisting of hegari, Sumac (Red Top) sorgo, and Sudan grass, all grown without irrigation. The fields are not cropped regularly but only when the moisture supply is sufficient to produce some feed, and heavy yields are obtained when moisture conditions are favorable. On one such field hegari is reported to have yielded 12 tons of silage in a season from two cuttings. Without irrigation, however, yields fluctuate widely from year to year. None of the soil is irrigated in this county. Several large tracts are under irrigation in Zavala County to the east, and yields of 250 to 300 bushels of spinach, 250 to 300 bushels of dry onions, 5 tons of dry sorghum fodder, and 26 bushels of corn an acre are reported.

This soil is suited to the production of staple crops, especially feeds for livestock, rather than for fruits or vegetables. Some vegetables, including cabbage, green onions (for plants), and a few others, do well. The surface soil and the subsoil are too heavy for the best growth of fruit trees.

Owing to the absence of readily available water for irrigation, not much of this soil can be used for irrigated crops until more adequate facilities can be provided, either from the Rio Grande or impounded rain water in artificial reservoirs.

In places the divergence from the characteristic native vegetation on the virgin soil is marked by a heavy growth of the saladillo plant, with few trees or shrubs common to the soil, although the growth of curly mesquite is fairly abundant. The presence of saladillo generally indicates some form of salinity, and in places where it grows the surface at times has a powdery white coating where water has remained, or along irrigation laterals. Analyses made of similar soils in the region indicate an abundant supply of calcium carbonate, calcium sulfate, and other salts, with, in places, a somewhat high content of sodium chloride.

The areas where the saladillo plant grows are rather well suited to native pasture, as curly mesquite furnishes grazing when moisture conditions are favorable, and it is reported by ranchmen that saladillo satisfies the salt requirements of livestock so that no salt needs to be provided. The soil probably furnishes about 20 cow-acre-days of grazing.

SOILS OF MODERATE TO LOW PRODUCTIVE CAPACITY

The group of soils of moderate to low productive capacity, consisting of five members, includes soils that, although sufficiently deep, smooth, and extensive for favorable cultivation, have only a moderate to low productive capacity. Under special conditions some of them may be cropped successfully, but when all other factors are equal their productive capacities are lower than those of the first group. This group includes two medium-textured soils, Maverick clay loam and Zapata silty clay loam; one sandy soil, Laredo loamy very fine sand; and two clay soils, Leona clay and Maverick clay.

MEDIUM-TEXTURED SOILS

Maverick clay loam.—The surface soil of Maverick clay loam is grayish-brown or brownish-gray crumbly calcareous clay loam, about 8 inches thick, which merges with brownish-yellow, yellow, or yellowish-gray compact heavy calcareous clay or sandy clay showing a prismatic structure in exposed cuts. The subsoil breaks into small angular slick-faced aggregates, 1 or 2 inches thick. This layer may be very thin or absent, or it may have a maximum thickness of 20 inches. At a depth ranging from 10 to 40 inches, this passes into yellow tough calcareous clay, with a structure somewhat similar to that of the layer above, except that the clods are larger and many white chalky lumps are present, indicating the horizon of lime accumulation. At a depth ranging from 36 to 96 inches, this rests on calcareous partly disintegrated shaly sandstone or grades into shaly clay. In places small fragments of oystershells occur in the parent material. In some areas the surface is strewn with a few small scattered rounded particles of gravel of chert and igneous rock.

This soil occurs on the lower slopes, hill shoulders, and narrow divides, in association with other Maverick soils and Monteola soils. As a rule it occupies more sloping areas than the Monteola soils, but some of the better areas are rather smooth and the slope is very gentle. The total area is large.

The parent materials are disintegrated shales and sandstones of Upper Cretaceous and Tertiary ages. These materials are similar to those upon which soils of the Monteola series have developed. The slope of the land affords free surface drainage, and on some of the steeper slopes erosion is rather severe. Internal drainage is slow.

The native growth on this soil consists of scattered small to medium-sized mesquite trees, dense blackbrush areas, brasil, granjeno, amargosa, huisachillo, paloverde, guayacan, *Coldenia canescens*, and cudweed, with a 20- to 25-percent grass cover of red grama. Practically no grass grows on the more sloping areas where the blackbrush thickets occur, but the large variety of brush cover affords considerable browse. Probably 18 cow-acre-days of grazing are afforded by this soil.

None of this soil is cultivated in Maverick County. In Dimmit County some of the smoother areas have been farmed under irrigation, but apparently results have not been very satisfactory, as many of the farms have been allowed to revert to pasture. Feed crops, such as sorghums, do fairly well, and onions are said to give moderate yields.

In places, Maverick clay loam occupies long gently sloping outwash fans along the bases of slopes and escarpments of rough stony land. The soil here ranges from a few inches to as much as several feet in thickness. It overlies dense calcareous shaly clay from which Maverick and Monteola clays normally develop, or in places it covers normal Maverick clay. In the normal or deeper soil areas, the surface soil, to a depth ranging from 10 to 20 inches, is calcareous brown, brownish-yellow, or brownish-gray friable clay loam of laminated structure. This grades into brownish-yellow or brownish-gray calcareous silty clay containing various quantities of angular sandstone and shale fragments and soft lumps of calcium carbonate. Below a depth of 3 to 4 feet the soil rests on calcareous sandstone or shale, or grades into yellow shaly clay. The surface is gently sloping, and this variation of Maverick clay loam is in places cut by many gullies. It is strewn with rounded gravel, shale, and sandstone fragments, indicating rapid drainage. About 3 square miles of this variation occur in the county. The native vegetative cover on this soil consists of scattered small mesquite trees, huisachillo, paloverde, creosotebush, guayacan, and blackbrush. The grass cover occupies from 15 to 25 percent of the land and is mostly red grama. None of this included soil is in cultivation, but probably some of the areas below the main canal of the irrigation district in the vicinity of Eagle Pass and farther south will be placed in cultivation in association with other more productive soils. Fair yields of forage and some vegetable crops may be expected in places where the soil is fairly thick.

Zapata silty clay loam.—The 10-inch surface soil of Zapata silty clay loam is brownish-gray or gray calcareous silty clay loam of granular structure. A small quantity of chert and quartzite gravel is on the surface and in the surface soil. The subsoil is brownish-yellow or brownish-gray calcareous silty clay, containing much small rounded gravel and, in places, subangular sandstone fragments with the gravel. At a depth of about 20 inches this material rests on brownish-yellow or brownish-gray calcareous shaly clay, which has developed from deeply weathered shale. This is similar to the parent material from which Maverick clay is developed, but it is covered with a superficial veneer of silty clay loam and gravel, outwash materials similar to those that give rise to the Reagan soils. In places, spots of Maverick clay, too small to map on the scale used, are present.

This soil is rather extensive in the vicinity of Eagle Pass where the ancient gravel terrace that parallels the Rio Grande Valley, and from which the Reagan soils are developed in this county, has eroded, leaving only remnants superimposed on the calcareous shales and sandstones of Cretaceous and Tertiary age from which the Maverick and Monteola soils are developed. These remnants of the ancient terrace comprise the material from which this soil is developed.

This soil occupies undulating to rather sloping surfaces, and surface drainage is rapid, but underdrainage is slow. Some gully erosion has occurred in the soil in places.

The native vegetation consists of a small scattered growth of trees and shrubs and a 15- to 20-percent grass cover. The shrubs are largely paloverde, leatherweed, huisachillo, mesquite trees, allthorn, amargosa, cenizo, guayacan, and *Coldenia canescens*. The grasses are chiefly

red grama and three-awn. This growth probably affords about 16 cow-acre-days of grazing.

A very small proportion of the soil is cultivated in the vicinity of Eagle Pass. This is farmed dry, producing an occasional yield of feed crops. Although this is not a strong soil, small areas where the soil is deeper may produce small quantities of feed crops, especially sorghums and Sudan grass.

SANDY SOILS

Laredo loamy very fine sand.—This soil consists of light grayish-brown calcareous loamy very fine sand, about 12 inches thick, grading into light yellowish-brown or yellowish-gray calcareous loamy very fine sand, which, although of single-grain structure, is slightly heavier than the surface soil. The material shows no indication of an accumulation of calcium carbonate and continues without change to a depth of several feet.

This soil occurs on the outer edge of the low terrace in the Rio Grande Valley. Other Laredo soils also occur on this terrace, which lies from 10 to 20 feet above the vega, the present flood plain of the Rio Grande. A small total area is mapped.

Most areas are nearly flat or slightly undulating, but gently sloping areas lie on or near the outer edge of the benches. The surface slope is adequate for all purposes of irrigation and drainage, but the loose surface soil and subsoil allow excessive underdrainage. The soil consists of alluvial materials that have changed but slightly since their deposition by the Rio Grande.

The native vegetation consists of scattered mesquite trees, brasil, and granjeno. The 15- to 25-percent grass cover is composed mainly of three-awn and red grama.

Much of the soil is in cultivation, but it is not so productive as the other soils of the Laredo series. It seems better suited to the production of vine and root crops, such as melons, sweetpotatoes, cucumbers, squashes, tomatoes, peas, and peanuts. Onions, spinach, cabbage, and forage crops produce low yields.

The loose porous character of Laredo loamy very fine sand allows the rapid seepage of irrigation water, and irrigation canals should have impervious linings in order to preserve the water. Water and plant nutrients leach from the soil rapidly, and it seems certain that continued use of the soil would make fertilizers necessary to produce fair yields.

CLAY SOILS

Leona clay.—Leona clay consists of very dark brownish-gray or black heavy calcareous clay ranging from 20 to 40 inches in thickness, which gradually merges with calcareous gray clay. In some places sandy clay or sandy clay loam lies at a depth of 2 to 3 feet.

This soil occurs mostly in narrow bands paralleling the creek channels or in sloughs and narrow drains, but all the soil is first-bottom alluvium occupying the lowest positions and is flooded more frequently than other valley soils. Some rather wide areas, similar to the "bayoucas" near Crystal City in Zavala County, occur on Picoso, Salado, and Chilli Piquin Creeks. About 37.5 square miles of the soil is mapped.

For the most part the surface is flat and depressed, but in places it is rigid and bumpy, owing to the currents of the floodwaters that deposited the sediments. These sediments represent materials washed from the local uplands.

The soil usually supports a dense growth of mesquite trees, catclaw, retama (horsebean or Jerusalem-thorn), hackberry, and live oak. *Aster spinosus* and many other weeds are abundant. The 10- to 25-percent grass cover consists of curly mesquite and many coarse grasses. In places the soil is bare of a ground cover, owing to frequent flooding or to water standing on the land for protracted periods. The vegetation furnishes approximately 16 cow-acre-days of grazing.

None of the soil is cultivated, owing to hazards from floods and to its small extent. It probably would be highly productive under controlled conditions of moisture and would seem to be especially suited to feed crops.

Maverick clay.—The surface soil of Maverick clay is brown or yellowish-brown crumbly calcareous clay, ranging from 4 to 10 inches in thickness. It grades into dark-yellow or brownish-yellow heavy calcareous clay containing soft white lumps of calcium carbonate and much crystalline gypsum. The calcium carbonate lumps are lacking in some places, but the gypsum crystals are abundant in most places. At a depth ranging from 5 to 8 feet the clay rests on yellow calcareous shale. In places a few particles of rounded chert and igneous rock gravel and some large shells are in the soil and scattered on the surface.

This soil occurs in association with other soils of the Maverick and Monteola series and occupies undulating to moderately steep slopes where erosion is active. In places both sheet and gully erosion are severe, and from some spots the surface soil is gone entirely. The soil, as a whole, shows only thin soil development, the parent materials of calcareous shales and clays of Upper Cretaceous and Tertiary ages being changed only slightly.

Surface drainage is rapid, but internal drainage is slow. This soil occupies a fairly large total area.

Much of the surface is entirely bare of vegetation, but stunted scattered mesquite trees, brasil, guayacan, blackbrush, amargosa, and pricklypear grow in places. The grass cover ranges from 15 to 20 percent and consists largely of mesquite, tobosa, red grama, and three-awn. The grazing and browse afforded by this vegetation amounts to about 12 cow-acre-days.

The soil is not cultivated, is not inherently productive, and is subject to erosion. Much of it lies where no irrigation water is available. The better and deeper areas would probably produce small yields of feed crops under irrigation.

In places a variation of this soil occurs, which differs from the typical soil chiefly in the vegetative cover and probably in salinity. The soil consists of a 3- to 8-inch layer of brown calcareous clay underlain by yellow dense calcareous clay, which has a prismatic structure with perpendicular cracks and contains white lumps of calcium carbonate. The color becomes more yellow with depth, and below a depth of 2 feet the material is tough yellow or yellow and gray calcareous clay containing many gypsum crystals. At a depth of 30 to 40 inches calcareous shaly clay is reached. About 7 square miles of this variation occurs in the county, mainly along Sauz Creek

in the southern part and northeast of Eagle Pass near the irrigation canal. Smaller areas are scattered over the central part. Its sloping surface subjects the soil to gully and sheet erosion. The shrubby vegetation is even more stunted and sparse than that on the typical soil, although it includes mainly the same species. In places the land supports a dense carpet of curly mesquite, but the total grass cover is estimated at only 5 to 15 percent. Saladillo is abundant on this soil but does not grow at all on the typical soil. The grazing and browse afforded by the vegetation is approximately 14 cow-acre-days. All this inclusion is used as native pasture, for which it is probably as valuable as the typical soil, because of the scattered areas covered with curly mesquite. Small quantities of feedstuffs might be produced under irrigation, but cultivation of this included soil probably will not be attempted.

MISCELLANEOUS SOILS AND LAND TYPES UNSUITED TO CULTIVATION

The group of miscellaneous soils and land types unsuited to cultivation includes Zapata fine sandy loam, Zapata loam, Reagan gravelly loam, Webb gravelly fine sandy loam, Randall clay, rough stony land, and rough broken land. These soils and land types combined occupy 140.7 square miles, or 11 percent of the total area of the county. Although not arable, some of them are valuable for grazing.

Zapata fine sandy loam.—The surface soil of Zapata fine sandy loam consists of grayish-yellow or grayish-brown calcareous fine sandy loam, about 8 inches thick. It grades into brownish-yellow, grayish-yellow, or yellow calcareous fine sandy loam containing many fragments of sandstone and some of hardened platy caliche. This rests, at a depth ranging from 12 to 20 inches, on beds of thin-layered calcareous gray sandstone which is generally coated and interbedded with hardened thin white layers of caliche. These beds are from 3 to 10 feet thick and rest on massive soft calcareous sandstone or thick-bedded sand containing lumps of white chalky material.

This soil occupies outcrop areas of soft calcareous sandstone of Upper Cretaceous or Tertiary ages. It occupies many small and some fairly large areas in the central, northern, and eastern uplands of the county. As the soil occurs in close association with Maverick fine sandy loam, small areas of that soil may be included on the map.

The native vegetation consists of a moderately dense to scattered growth of medium-sized to large trees and shrubs and a thin grass cover. The trees and shrubs consist of mesquite, blackbrush, brasil, granjeno, Texas lotebush, pricklypear, leatherweed, guajillo, creosotebush, and tasajillo. The 15- to 20-percent grass cover is mostly three-awn and red grama. The carrying capacity of this vegetation is about 15 cow-acre-days.

None of the soil is cultivated systematically, but at some ranch headquarters small vegetable gardens seem to thrive where the combined surface soil and subsoil are from 15 to 20 inches thick over the sandstone. In small areas such as these, which are very limited in number, crops will produce fair yields under irrigation, but the soil is not generally suited to cultivation.

Zapata loam.—The surface soil of Zapata loam is light grayish-brown or brownish-gray calcareous loam, ranging from 4 to 24 inches in thickness. It contains small fragments of hardened caliche, from ¼ to 2 inches thick, and some rounded quartz, limestone, chert, and other gravel. In most places gravel and caliche fragments are also scattered on the surface. The soil rests on beds of calcium carbonate caliche and gravel. The gravel beds range from 1 foot to 40 feet in thickness and comprise old plains outwash materials resting on calcareous clays and shales of Upper Cretaceous and Tertiary ages. As a rule the caliche caps the gravel beds, but in places it binds the gravel into hard masses. The surface of the caliche bed just under the soil layer generally is very hard and smooth on the upper side. Under this hardened platy upper crust, which is from ½ to 2 feet thick, the massive caliche bed is much softer.

This soil lies on the ancient gravel beds of the Reynosa formation, and it is associated with soils of the Reagan series. These old terrace plains are confined largely to a 6- to 8-mile strip on the uplands paralleling the Rio Grande Valley, but some small areas are isolated from the main bodies in the eastern part of the county. They represent remnants or outliers of the old outwash mantle on which the soils of the Reagan and Zapata series are developed. The surface is a high nearly flat to undulating plain with free drainage. A fairly large total area of the soil occurs in the county.

This soil is characterized by a distinctive vegetation of scattered small trees and shrubs, largely paloverde, guajillo, cenizo, creosote-bush, guayacan, *Coldenia canescens*, and mesquite trees, and a 10- to 15-percent grass cover, chiefly three-awn and red grama. Large grassy areas, free from all brush, are common on this soil. This vegetation affords about 20 cow-acre-days of grazing and browse. guajillo and red grama are reported to be the most valuable native pasture plants. Owing to the very shallow soil and loose porous substratum, this soil is considered of practically no value for cultivated crops.

Reagan gravelly loam.—Reagan gravelly loam occurs on beds of rounded limestone, chert, quartz, and igneous rock gravel, ranging from 3 to 30 feet in thickness. The topmost 8 to 10 inches of the bed contains considerable light-brown or gray calcareous loam, but below this is either gravel cemented by hardened caliche or caliche without gravel. The upper surface of the caliche generally is hard and smoothly rippled. The hardened layer is platy and ranges from several inches to several feet in thickness. Below this layer the caliche is softer and of massive structure. Caliche beds range from only a few feet to many feet in thickness. They rest on other beds of gravel or calcareous shales and clays. Where they rest on gravel, the gravel bed, in turn, rests on the calcareous shales and clays.

This soil occupies large greatly dissected areas on the steeper slopes leading to the Rio Grande Valley and the larger tributary valleys. The surface is undulating to steeply sloping. The soil represents the lower part of the ancient outwash plain of the Reynosa formation, which parallels the Rio Grande Valley. Short tributaries have cut deeply into the gravel beds. Drainage is exceedingly rapid, and erosion is active. A large total area is mapped.

This soil produces an abundant growth of guajillo, cenizo, rockbrush, leatherweed, whitebrush, blackbrush, mesquite trees, and brasil. The grass cover of 15 to 20 percent consists of red grama and three-awn, with some pappusgrass. Guajillo and cenizo predominate, the former affording excellent browse for livestock. The vegetation affords probably about 20 cow-acre-days of grazing. The soil is entirely unsuited for cultivated crops.

Webb gravelly fine sandy loam.—The 10-inch surface layer of Webb gravelly fine sandy loam consists of red or brownish-red noncalcareous gravelly fine sandy loam. The gravel is chiefly of rounded limestone, chert, and quartz, but some igneous rock gravel also is present. The gravelstones range from ¼ to 4 inches in diameter. Less soil material and more gravel are in the lower part of the layer. Considerable caliche is beneath the surface, and in places the gravel bed is cemented by hard massive caliche.

This soil occupies a few rather small bodies on the topmost part of the ancient Reynosa outwash plain in close association with Reagan gravelly loam, and everywhere is developed above the Reagan soils in topographic relationship. As the soil occupies the uppermost parts of the ancient terrace, the surface is smoothly undulating. It is developed from the Reynosa outwashed gravel beds, and drainage is rapid.

As this is a nonarable soil, its value lies in the grazing and browse it affords. The characteristic native growth consists of guajillo and cenizo, which grow vigorously, scattered rockbrush, blackbrush, whitebrush, leatherweed, tasajillo, brasil, and mesquite trees, with a 15- to 20-percent cover of red grama and three-awn and some pappusgrass. The grazing and browse value of this vegetation is about 20 cow-acre-days.

Randall clay.—Randall clay consists of dark grayish-brown or dark-gray tough clay which generally is noncalcareous. It is several feet thick, becoming more dense, coarsely cloddy, and lighter in color in the lower part. The surface in many places is pitted with deep so-called hog wallows, but the character of the soil in these shows little difference. The soil is alluvial or colluvial in origin and is derived from materials that have washed to their present location from adjacent areas. It occupies shallow lake beds, ranging from several acres to 100 acres or more in size, which occur on the smooth areas northeast of Normandy and also within the large areas of Monteola clay on the uplands of Burr ranch. Locally these lake beds are called lagunas. They are dry most of the time, but after rains water stands several feet deep in them for protracted periods. This is an inextensive soil.

The surface is flat and depressed. It is bare of vegetation in places, but in other places it supports a growth of retama, mesquite trees, broomweed, sneezeweed, blueweed, beebalm or horsemint, sunflower, and a 5- to 25-percent grass cover, chiefly buffalo grass, curly mesquite, and tobosa. The outer edges of these areas in most places are circled by large and more dense vegetation consisting of small trees and shrubs of mesquite, hackberry, retama, brasil, huisache, granjeno, and others. Large solitary mesquite or hackberry trees are scattered about in places near the centers of the areas. Probably because of the more succulent growth in places in the depressed areas of Randall clay, the cattle congregate here in dry periods. It is estimated that

about 20 cow-acre-days of grazing and browse are afforded by the vegetation on this soil.

Rough stony land.—Rough stony land occupies steep slopes and escarpments in the areas adjacent to the larger valleys. The crests of the slopes have outcrops of sandstone, and large and small rock fragments broken from the main ledges have fallen and become thickly scattered over the slopes below. The soil material of the slopes is brown clay over shale, which lies near the surface. The slopes are steep and subject to severe erosion. The land is entirely nonarable. Tobosa and other grasses comprise only a very thin cover. The shrub vegetation consists chiefly of guajillo, cenizo, guayacán, rockbrush, brasil, and small mesquite trees. The land affords only a small amount of grazing and browse for the range livestock. It is not of great extent and is used only for pasture.

Rough broken land.—Rough broken land comprises steeply sloping escarpments of valleys and benches of old terraces and also eroded and gullied more or less sloping areas throughout the uplands, largely in areas associated with Maverick soils, near the upper slopes of the Rio Grande Valley. This is mainly a badland type—land so severely cut by erosion that cultivation is impossible and the land has little value for range forage. A very thin cover of grass, not exceeding 5 percent, affords scant grazing, and the scattered shrubs afford a small amount of browse. Some of the very narrow gullied and eroded steep escarpments of the Laredo soils on terraces of the Rio Grande Valley are more or less sandy, representing outcrops of old alluvium. Here, some coarse grasses and shrubs afford a small amount of range forage. This land is of very small extent.

LAND USES AND AGRICULTURAL METHODS

More than 97 percent of the land in Maverick County is in native pasture used for the maintenance of range livestock consisting of cattle, sheep, and goats (pl. 1, *A*, *B*, and *C*). The remaining land is in cultivation, mostly under irrigation, but some is dry farmed. According to the census, 460 farms were reported in Maverick County on January 1, 1935, most of which were large bodies of land used as ranches. In 1934, 7,778 acres were reported in cultivation, of which 141 farms reported crops harvested from 6,788 acres, and 12 farms reported 990 acres of land in crops having crop failure. In that year 130 farms reported 6,283 acres cultivated under irrigation.

Ranching consists mainly of maintaining young steers on native pasture to an age of 2 to 4 years, after which they are sold to feeders in the North. Although most of the young cattle are purchased outside the county, some are produced locally. The region is regarded generally as steer range rather than breeding range. The brushy growth that covers most of the region makes the proper care of calves difficult, and losses from screw worm infestation are heavy under these conditions. Sheep and goats are produced chiefly for wool, mohair, milk, hides, and meat.

Ordinarily the native growth of grass, brush, and forbs of the area is a sufficient source of feed for the range livestock carried. Insufficient moisture limits the density and growth of vegetation, however, although much of it is highly nutritious. Probably more

than 50 percent of the range sustenance for livestock is obtained from shrubs rather than from grasses or forbs. Deep-rooted shrubs afford succulent browse of flowers, leaves, and fruits over long periods, whereas the shallow-rooted grasses and forbs provide adequate grazing for comparatively short periods. The more valuable grass plants are curly mesquite, red grama, hairy grama, tobosa, and buffalo grass, of which hairy grama and buffalo grass constitute only very small proportions of the grass cover. The valuable browse plants are blackbrush, which affords blossoms, leaves, and beans in various seasons; guajillo, which provides valuable beans and leaves; mesquite trees, which produce nutritious beans and leaves; catclaw, rockbrush, huisachillo, and numerous others. Pricklypear is a fair reserve crop that can be utilized by burning the spines off with a torch. The mesquite tree, in addition to valuable browse, furnishes fence posts and fuel. Although not valuable for commercial lumber, it is used on the ranches in the construction of houses, corrals, and sheds. The average carrying capacity of the native range is about 18¼ cow-acre-days, or 20 acres per animal per year. Auxiliary feeding is resorted to only when the native vegetation is insufficient, as during prolonged droughts, but is discontinued when the native forage is renewed. Sometimes droughts are sufficiently severe to require removal of livestock to distant pastures.

Water for livestock is obtained from tanks (earth reservoirs), which catch and hold the run-off waters, and from the Rio Grande, natural water holes in creeks or arroyos, and wells. Well water is limited to a few sections. Most of the wells are in the Carrizo sand formations along the eastern margin of the county, but a few are in the ancient outwash gravel beds of the Reynosa formation and on valley benches and vegas of the Rio Grande. The vast central part of the county must depend on tank water, as the well water available usually is too saline to be palatable, even for livestock.

Usually cattle, sheep, and goats are grazed separately. According to V. L. Cory, of the Texas Agricultural Experiment Station,[13] this system does not utilize the natural forage most economically and may result in deterioration of the range. Cattle, sheep, and goats have different preferences for range vegetation. Where one type is used to the exclusion of others, some plants disappear and others increase. Obviously, some of the forage is wasted and the carrying capacity for the kind of livestock used is reduced. The fullest and most economical use of the range is obtained when combinations of cattle, sheep, and goats are grazed in rotation. In this manner a larger part of the forage is profitably used and the vegetation ratios are maintained more nearly constant. Such range utilization requires comparatively small pastures with numerous water supplies, in order that the vegetation may be given ample opportunity to recover from grazing by shifting the herds and flocks from pasture to pasture.

At present there seems to be a tendency toward finishing some cattle in the county, and this probably will continue as more land comes into cultivation. If slaughter and packing facilities were established locally, the trend toward finishing the cattle would be greatly stimulated.

[13] CORY, V. L. ACTIVITIES OF LIVESTOCK ON THE RANGE. Tex. Agr. Expt. Sta. Bul. 367, 47 pp., illus. 1927.

Cultivated crops were produced as early as 1880, but there was no large commercial production until recently. At present less than 3 percent of the soils are thus employed, and most of these are on benches of the Rio Grande Valley under irrigation. Some dry farming is carried on intermittently in the uplands. The chief crops thus grown are hegari, which is cut and stacked for fodder; Sumac (Red Top) sorgo cut for hay; and Sudan grass, which is grazed in the field during the spring and summer. These crops are planted only when moisture conditions seem favorable and feed is needed to supplement the native forage.

Under favorable conditions large yields of these feed crops are obtained. Yields fluctuate widely, however, as it is not always possible at planting time to predict the moisture conditions that will prevail throughout the growing season. The principal soils used for dry farming are Monteola clay, Monteola clay loam, Webb fine sandy loam, Crystal fine sandy loam, Uvalde clay, and Uvalde silty clay loam.

The principal irrigated soils of the Rio Grande Valley are Laredo very fine sandy loam, Laredo fine sandy loam, Laredo loam, Laredo loamy very fine sand, Uvalde clay, Uvalde silty clay loam, and Reagan loam, colluvial phase. Very small areas of alluvial soils, undifferentiated, also are used. Large bodies of soils suitable for irrigated crops occur throughout the county. These will probably remain in native pasture for many years, as water for irrigation is not available and present economic conditions do not require this additional land for crops.

The chief irrigated crops are sorghums, spinach, onions, tomatoes, cabbage, carrots, peppers, cucumbers, okra, cowpeas, beans, cantaloups, watermelons, sweetpotatoes, other vegetables, popcorn, field corn, and cotton. Spinach, onions, sorghums, popcorn, and field corn are the chief commercial crops. Vegetables are grown in the fall and winter, with a minor acreage in the spring, and the staple crops are grown in the spring and summer.

In general, the best forage crops are produced on the fine-textured soils and the best vegetables on the coarse-textured soils. The coarser textured soils are warmer and favor the production of winter vegetables. The fine-textured soils, however, have more natural fertility and, as a rule, give the highest yields when other factors are equal.

The most satisfactory soils for onions and spinach seem to be Laredo very fine sandy loam, Laredo loam, and Laredo fine sandy loam (pl. 2, *A* and *B*). Hegari is the most commonly grown grain sorghum, and under irrigation large yields are obtained on such soils as Uvalde silty clay loam (pl. 2, *C*). Corn and Sumac (Red Top) sorgo yield well on these soils. Corn yields fluctuate widely, even under irrigation, but fairly high yields are obtained when conditions are favorable at the time of pollination.

Practically no fertilizers are used. Occasional applications on onions grown on Laredo very fine sandy loam and Laredo loamy very fine sand have given some increases in yields but have not provided a basis for definitely established fertilizer use.

Because of newness of agricultural development, a settled routine of cropping and cultural practices has yet to be established. The merits of many crops, the fertilizer requirements of the different

soils, measures for control of pests, and rotations have yet to be demonstrated, generally accepted, and practiced by the farmers.

On land devoted to commercial production of spinach and onions, only one crop is produced each year. During the rest of the year the land lies fallow. Usually these two crops are grown on the same land year after year. This practice is reducing yields, as it favors loss of humus through oxidation during the fallow period and increase in weed, insect, and disease infestation. This method might possibly be improved by growing a green-manure crop during the summer. The broadcast method of planting spinach encourages weed infestation, and weeds increase the probability of disease and insect damage to the crop. Spinach is planted from September to early February. The marketing of the crop is thus spread over a long period, but the prices fluctuate considerably throughout the season. The Savoy type of spinach is generally grown.

The Yellow Bermuda onion is generally reported to be the best suited variety. Most of the seed comes from the Canary Islands. It is sown in seedbeds late in September, and the plants are transplanted to the field in rows by late November. The crop is harvested from March to June. Much of the work in connection with this crop is hand labor. The crop is subject to a disease known as pink root and is often damaged greatly by insects, chiefly thrips. These may be combated by rotation, use of fertilizers, or other cultural practices that encourage continuous and sturdy growth.[14]

Pritchard, Bonny Best, and Marglobe are the most common varieties of tomatoes. Tomatoes are planted the last two weeks of July for October and November harvests. On a few farms a small amount of 11–48–0 fertilizer has been applied for tomatoes at the rate of 100 pounds an acre, and reports indicate an increase in yields.

Cabbage is grown during the winter and yields very well on the dark heavy soils. Large yields of carrots of high quality are produced. Those of the highest quality are grown on the sandy soils of the Laredo series. Beets are grown in widwinter. Fall peppers are produced on a small scale and do well. The chief varieties are California Wonder and World Beater.

All kinds of beans and cowpeas yield well in either spring or fall plantings. They grow on most of the soils but turn yellow where the soil has a high concentration of calcium carbonate. Sweetpotatoes give heavy yields but are said to be not of the best quality.

Spring cantaloups of excellent quality are grown on the sandy Laredo soils and give heavy yields when insects are controlled. Aphids are the most destructive insects. Hale Best and Rocky Ford are the cantaloup varieties generally grown. Watermelons grown here are of moderate size and quality.

The chief varieties of corn are Surcropper and Mexican June. This crop is planted in late January or early February and harvested in June or July. Good yields are obtained on the more fertile soils when the humidity is sufficient during the pollination periods. Popcorn gives promise of being a successful spring and summer crop.

The sorghums are especially well suited to the soils and climate of this county. Some of them are produced under dry farming, but uni-

[14] HAWTHORN, LESLIE R. BERMUDA ONION CULTURE IN TEXAS. Tex. Agr. Expt. Sta. Cir. 65, 14 pp., illus. 1932.

formly heavier yields are obtained under irrigation. Sumac (Red Top) sorgo is grown for hay, and hegari and other grain sorghums are produced for fodder. They yield well under irrigation.

Sudan grass gives heavy yields under irrigation and is planted for spring and summer grazing. Alfalfa makes a good growth, yielding a ton an acre per cutting, but it is heavily damaged by root rot. Cotton also has suffered greatly because of insect damage and root rot.

At substation No. 19 of the Texas Agricultural Experiment Station, located at Winter Haven in Dimmit County, experimental work is carried on in an effort to solve the agricultural problems of the region. As this substation was not established until 1929, many experiments are not sufficiently advanced for definite interpretation of results at this time, but numerous facts concerning local problems have already been published. The substation is located on red sandy upland soils, mainly of the Webb and Crystal series. These soils are inextensive and little used in crop production in Maverick County, but many of the experimental results at the substation have practical application in regard to the management and methods employed on Maverick County farms. In addition to the work at the substation farm, field tests on the more representative soils of the region that the substation serves are being made in cooperation with various farmers. Cooperative fertilizer tests with spinach and onions are being made in Maverick County on Laredo very fine sandy loam.

Valuable work has been done and published on variety tests of vegetables.[15]

The evaporation records and irrigation experiments of the station are of practical value in this county. In growing onions, these experiments have shown that a minimum amount of irrigation with greater frequency of application during the bulbing period increases yields. A minimum number of irrigations for spinach also appears most satisfactory.[16]

PRODUCTIVITY RATINGS

In table 5 the soils of Maverick County are rated according to their productivity for the important crops grown under prevailing conditions and systems of irrigation and dry farming. The soils are listed in the order of their general productivity under irrigation.

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[15] HAWTHORN, LESLIE R. VEGETABLE VARIETIES FOR THE WINTER GARDEN REGION OF TEXAS. Tex. Agr. Expt. Sta. Bul. 508. 139 pp., illus. 1935.

[16] MORTENSEN, E., and HAWTHORN, L. R. THE USE OF EVAPORATION RECORDS IN IRRIGATION EXPERIMENTS WITH TRUCK CROPS. Amer. Soc. Hort. Sci. Proc. 30: 466–469. 1933.

TABLE 5.—*Productivity rating for soils of Maverick County, Tex.*

Soil type [1]	Irrigation farming									Dry farming and grazing			
	Crop productivity index [2] for—								Land classification [3]	Crop productivity index [2] for—			Land classification [3]
	Spinach	Onions	Tomatoes	Cabbage	Carrots	Sorghums (dry fodder)	Corn (grain)	Sown pasture		Sorghums (dry fodder)	Corn (grain)	Native pasture	
Laredo silt loam	100(200)	100(115)	100(150)	90(100)	100(135)	200	45	210	Excellent cropland.	30	15	20	
Laredo loam	100(200)	100(115)	100(150)	90(100)	100(135)	200	45	210		30	15	20	
Laredo silty clay loam	95	70	75	100	45	200	60	210		65	30	15	
Laredo very fine sandy loam	100(200)	100(115)	100(125)	50(80)	100(120)	165	50	210		30	15	20	
Laredo fine sandy loam	85(200)	100(115)	100(125)	50(80)	100(120)	165	50	210		50	15	20	
Uvalde silty clay loam	95	60	75	100	55	150	50	210		65	25	20	
Uvalde silty clay loam, high phase	95	60	75	100	55	150	50	210		65	25	20	
Reagan silty clay loam [4]	80	60	75	90	55	150	50	215		50	25	20	
Reagan loam, colluvial phase	70(140)	55(80)	75(100)	60(100)	70(100)	150	45	215		30	20	20	
Uvalde clay	70	60	50	90	45	150	50	200	Good cropland	30	20	20	Fair to poor cropland or grazing land.
Monteola clay loam	70	60	75	90	55	130	50	215		50	25	20	
Monteola clay	70	60	50	90	45	130	50	200		30	20	20	
Alluvial soils, undifferentiated [4]	55	40	75	50	70	165	50	200		50	30	30	
Reagan loam [4]	55(115)	55(80)	50(100)	60(100)	70(100)	130	45	200		15	15	20	
Webb fine sandy loam	70(140)	25(70)	25(90)	45(90)	70(100)	150	50	170		50	20	20	
Maverick fine sandy loam	65(140)	40(70)	25(90)	40(80)	70(100)	150	50	165		65	30	20	
Crystal fine sandy loam	55(140)	20(70)	25(90)	30(80)	70(100)	130	45	150		50	25	20	
Maverick clay loam	55(100)	35(60)	15(50)	60(80)	45(80)	130	30	150		30	15	20	
Laredo loamy very fine sand	65(170)	40(60)	50(100)	20(50)	70(80)	100	30	140		15	15	20	
Leona clay [4]	30	20	15	50	25	115	40	160	Fair cropland	15	15	15	
Zapata silty clay loam [4]	45	20	15	50	40	115	30	140		15	15	15	

Maverick clay [4]	-----	-----	-----	-----	-----	65	-----	100	Poor cropland	-----	-----	10	Land suited only to grazing.
Zapata fine sandy loam [4]	-----	-----	-----	-----	-----	-----	-----	-----	Land generally unsuitable for irrigation.	-----	-----	20	
Zapata loam [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	20	
Reagan gravelly loam [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	20	
Webb gravelly fine sandy loam [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	20	
Randall clay [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	20	
Rough stony land [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	10	
Rough broken land [4]	-----	-----	-----	-----	-----	-----	-----	-----		-----	-----	10	

[1] The soils are listed in the approximate order of their general productivity under irrigation farming.

[2] The soils of Maverick County are given indexes that indicate the approximate average production of each crop in percentage of the standard of reference. See text for list of standards and explanation. Indexes in parentheses indicate yields obtained by the use of fertilizers.

[3] This is a general classification to indicate the physical suitability of the soils for farming or grazing. It is based largely on the general productivity of the soils but also takes into consideration workability and the problem of conservation.

[4] Little or none of these soils is cultivated.

Crop yields reflect the sum of the factors influencing productivity and form the basis for the determination of the productivity indexes. The rating compares the productivity of each of the soils for each crop to a standard, namely, 100. This standard index represents the productivity, without use of fertilizers or amendments, of the more productive soils of regions in which the crop is commonly grown. The standard indexes for corn, sorghums, and pasture are national standards, whereas those for the vegetable crops are regional; that is, they represent yields under good management on the better soils under irrigation in the Winter Garden district of Texas. Sufficient data are not available to establish satisfactory national standards for the latter class of crops. An index of 50 indicates that the soil is about half as productive for a specified crop as is the soil with the standard index. Soils given commercial fertilizers or amendments or unusually productive soils of small extent have indexes of more than 100 for some crops.

The following tabulation gives the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality.

Crop:		
Spinach (fall, winter, and early spring)	bushels	[1] 350
Onions (early spring)	do	[1] 500
Corn (grain)	do	50
Tomatoes (fall, green wraps)	tons	[1] 4
Cabbage (late fall, winter, and early spring)	do	[1] 10
Carrots (late fall, winter, and early spring)	do	[1] 15
Sorghums (dry fodder)	do	4
Pasture (sown and native)	cow-acre-days [2]	100

[1] These standards have been selected to represent yields under good management on the better soils under irrigation in the Winter Garden district of Texas.

[2] "Cow-acre-days" is a term used to express the carrying capacity of pasture land. (See footnote 12, p. 22.) For example, a soil capable of supporting 1 animal unit per acre for 360 days of the year rates 360, whereas another soil capable of supporting 1 animal unit per 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days, the rating is 25.

The column headed "Land classification" summarizes in a simple way the productivity and use capabilities of the various soils by placing them in a few groups on the basis of their relative suitability for farming and grazing. It is based largely on the general productivity of the soils but also takes into consideration workability and the problem of conservation. Soils classified as excellent cropland have general productivity indexes [17] of 95 or more; those classified as good cropland have general productivity indexes of 70 to 95; those classified as fair cropland, 30 to 70; and those as poor, below 30.

Large areas of arable soils remain in a virgin state and are used only for native pasture. These have been rated tentatively on the basis of their probable general average productivity for farm crops, as estimated by comparing their general characteristics to soils on which the average production is known and also by data obtained in other areas where some of them are cultivated. Fairly reliable data on yields were obtained for soils of the Laredo, Uvalde, Monteola, Webb, Maverick, and Crystal series.

[17] The general productivity index of each soil is determined by computing the weighted average of the specific crop indexes. The weights are based on the approximate acreage and estimated average net acre value of the individual crops.

This rating of the soils cannot be interpreted directly into specific land values. Monetary values are subject to change with economic conditions; whereas productivity, under proper land use and management, is more or less stable. Location in respect to markets and transportation facilities and the pattern of distribution of the soil types are also important factors in determining land values. For a number of soils, the data on which the ratings are based are not so complete as is desirable. When more complete data are available, certain changes in these ratings may be necessary.

CORRELATION OF SOIL TYPES WITH NATIVE VEGETATION

Correlation of the dominant native plants with individual soil types is of considerable value in this region, as production of native forage for livestock is the chief function of the soils at present. Some kinds of vegetation are of more value than others for grazing and browse. Observation has led to the knowledge that certain communities or types of vegetation are more or less consistently associated with definite soils, and that soils also influence the density and size of various plant species. A correlation, then, of the dominant vegetation, together with its density and size, for each soil type is a direct index to the relative value of the soil type for livestock carrying capacity. It is the general opinion of ranchmen that combinations of soil types, each with their characteristic vegetative cover, effect the most desirable of range conditions.

Table 6, showing the correlation of soil types with native vegetation, is based on observational studies in the field. The data are neither complete nor conclusive but form a basis upon which further studies may be made.

TABLE 6.—*Correlation of soil types with native vegetation in Maverick County, Tex.*[1]

Soil type	Principal trees, shrubs, and herbaceous plants [2]	Principal grasses [2]	Predominant ground cover
Laredo silt loam	Mesquite, whitebrush, granjeno, brasil, lotebush, guayacan, and desertwillow	Red grama and three-awn.	Dense growth of medium to large trees and shrubs; 10 to 15 percent grass.
Laredo loam	Mesquite, lotebush, and paloverde.	do	Scattered growth of medium-sized trees and shrubs; 20 to 25 percent grass.
Laredo silty clay loam.	Whitebrush, mesquite, hackberry, granjeno, and brasil.	do	Dense growth of whitebrush and large trees; 5 to 10 percent grass.
Laredo very fine sandy loam.	Mesquite, brasil, granjeno, whitebrush, and huisachillo.	do	Scattered growth of large trees and shrubs; 40 to 45 percent grass.
Laredo fine sandy loam.	Mesquite, brasil, and granjeno.	do	Scattered growth of medium-sized trees and shrubs; 15 to 25 percent grass.
Uvalde silty clay loam.	Mesquite, granjeno, brasil, lotebush, guayacan, huisachillo, pricklypear, guajillo, and catclaw.	Red grama, curly mesquite, and three-awn.	Scattered growth of large trees and shrubs; 25 to 30 percent grass.
Uvalde silty clay loam, high phase.	Mesquite, guajillo, granjeno, brasil, lotebush, guayacan, huisachillo, and catclaw.	do	Scattered growth of medium to large trees and shrubs; 25 to 40 percent grass.
Reagan silty clay loam.	Mesquite, huisachillo, catclaw, cenizo, pricklypear, brasil, granjeno, blackbrush, and guajillo.	Red grama, curly mesquite, tobosa, and three-awn.	Scattered growth of small trees and shrubs; 25 to 40 percent grass.

See footnotes at end of table.

TABLE 6.—*Correlation of soil types with native vegetation in Maverick County, Tex.*[1]—Continued

Soil type	Principal trees, shrubs, and herbaceous plants	Principal grasses	Predominant ground cover
Reagan loam, colluvial phase.	Mesquite, guayacan, *Coldenia canescens*, cudweed, paloverde, and prickly-pear.	Red grama, three-awn, and curly mesquite.	Dense growth of moderately large trees and shrubs with open grassy areas; 20 to 25 percent grass.
Uvalde clay	Mesquite, whitebrush, granjeno, tasajillo, prickly-pear, and catclaw.	Curly mesquite, buffalo grass, tobosa, and red grama.	Dense growth of rather large trees and shrubs; 30 to 40 percent grass.
Monteola clay loam	Mesquite, huisachillo, blackbrush, catclaw, prickly-pear, and tasajillo.	Red grama, three-awn, curly mesquite, and tobosa.	Medium-sized trees and shrubs; scattered to dense grass cover of 20 to 30 percent.
Monteola clay	Mesquite, huisachillo, blackbrush, tasajillo, prickly-pear, granjeno, brasil, and guayacan.	Curly mesquite and tobosa.	Dense to sparse growth of medium-sized trees and shrubs; mesquite, tasajillo, and curly mesquite dominant; 35 to 50 percent grass.
Alluvial soils, undifferentiated.	Mesquite, whitebrush, granjeno, brasil, aster, Mexican persimmon (black persimmon), willow, cedar elm, and hackberry.	Giant reed, Bermuda grass, pappusgrass, sacaton, and alkali sacaton.	Dense growth of large trees and shrubs; 15 to 25 percent grass, not including giant reed.
Reagan loam	Cenizo, guajillo, *Coldenia canescens*, cudweed, paloverde, lotebush, mesquite, catclaw, and creosotebush.	Three-awn and red grama.	Trees and shrubs small, cenizo dominant; 20 to 25 percent grass.
Webb fine sandy loam	Blackbrush, mesquite, huisachillo, brasil, guayacan, granjeno, desert yaupon, amargosa, paloverde, leatherweed, and jointfir.	Red grama, three-awn, pappusgrass, and curly mesquite.	Medium- to large-sized trees and shrubs, blackbrush dominant; 30 to 40 percent grass.
Maverick fine sandy loam.	Mesquite, brasil, granjeno, huisachillo, lotebush, guajillo, *Coldenia canescens*, cudweed, blackbrush, guayacan, paloverde, and pricklypear.	Red grama, three-awn, and pappusgrass.	Dense growth of moderately large trees and shrubs; 25 to 30 percent grass.
Crystal fine sandy loam.	Mesquite, brasil, granjeno, hog-plum, paloverde, lantana, verbena, leatherweed, and poppy-mallow (winecup).	Three-awn, field sandbur, and hairy grama.	Scattered growth of large mesquite and medium-sized shrubs; 40 to 45 percent grass.
Maverick clay loam	Blackbrush, mesquite, lotebush, amargosa, granjeno, huisachillo, paloverde, guayacan, *Coldenia canescens*, and cudweed.	Red grama	Medium-sized trees and shrubs, blackbrush dominant; 20 to 25 percent grass.
Laredo loamy very fine sand.	Mesquite, brasil, and granjeno.	Three-awn and red grama.	Scattered growth of small trees and shrubs; 15 to 25 percent grass.
Leona clay	Mesquite, catclaw, retama, cedar elm, live oak, hackberry, buttonwillow (buttonball bush), sneezeweed, and aster.	Buffalo grass and tall bunchgrass.	Dense growth of large trees and shrubs; 10 to 25 percent grass.
Zapata silty clay loam.	Paloverde, leatherweed, huisachillo, mesquite, allthorn, and amargosa.	Red grama and three-awn.	Scattered growth of small trees and shrubs; 15 to 20 percent grass.
Maverick clay	Mesquite, granjeno, guayacan, blackbrush, amargosa, pricklypear, and saladillo.	Curly mesquite, tobosa, red grama, and three-awn.	Scattered growth of medium-sized to small trees and shrubs; much bare ground; 5 to 15 percent grass.
Zapata fine sandy loam.	Mesquite, blackbrush, granjeno, lotebush, brasil, tasajillo, leatherweed, guajillo, creosotebush, pricklypear, and rockbrush.	Three-awn and red grama.	Scattered growth of moderately large trees and shrubs; 15 to 20 percent grass.
Zapata loam	Paloverde, cenizo, creosotebush, guayacan, *Coldenia canescens*, mesquite, and rockbrush.	do	Scattered growth of small trees and shrubs; 10 to 15 percent grass.
Reagan gravelly loam.	Guajillo, cenizo, rockbrush, blackbrush (black chaparral), and mesquite.	Red grama, three-awn, and pappusgrass.	Medium-sized to small trees and shrubs, guajillo and cenizo dominant; 15 to 20 percent grass.
Webb gravelly fine sandy loam.	Guajillo, cenizo, rockbrush, leatherweed, whitebrush, blackbrush, mesquite, and granjeno.	do	Heavy growth of guajillo; scattered growth of other trees and shrubs; 15 to 20 percent grass.

TABLE 6.—*Correlation of soil types with native vegetation in Maverick County, Tex.*[1]—Continued

Soil type	Principal trees, shrubs, and herbaceous plants	Principal grasses	Predominant ground cover
Randall clay	Mesquite, retama, granjeno, hackberry, sneezeweed, horsemint, bitter rubberweed, broomweed, plains sunflower, and blueweed.	Buffalo grass, curly mesquite, and tobosa.	Scattered growth of large trees and shrubs; 5 to 25 percent grass.
Rough stony land and rough broken land.	Guajillo, cenizo, guayacan, rockbrush, mesquite, and granjeno.	Tobosa, curly mesquite, red grama, and three-awn.	Scattered to moderately dense growth of small to large trees and shrubs; 5 to 20 percent grass.

[1] Species are listed in approximate order of density or importance for each soil. This is not a complete list but indicates the chief representative species of the important genera present.
[2] Botanical names of these plants are listed on pp. 4–7.

IRRIGATION

The first important irrigation in Maverick County was undertaken by private enterprise a few miles south of Eagle Pass, where water was pumped from the Rio Grande. Other irrigation developments followed, chiefly on the smooth productive Laredo soils on the low terrace benches of the Rio Grande Valley above the normal overflows that frequently inundate the lower bottoms. Areas so situated and selected for irrigation are at Hopedale and in the vicinities of Indio ranch, Loma Linda and Rosita farms, and other locations along the Rio Grande.

In 1932 the first unit of the gravity irrigation system of the Maverick County Water Control and Improvement District Number One, consisting of the Quemado Valley, a section of the Rio Grande Valley about 12 miles north of Eagle Pass, was prepared for irrigation. This irrigation is by gravity, and the water is carried in a canal from the Rio Grande. The land made available for irrigation in the Quemado Valley and vicinity was about 15,300 acres. The main canal now reaches some distance below Eagle Pass, and it is estimated that eventually the system can serve 60,000 acres. This irrigable area includes not only considerable bodies of soils in the Rio Grande Valley, some of which have long been irrigated by private pumping plants, and soils in valleys occupied by streams tributary to the Rio Grande, but also some soils of the smooth uplands.

Much smooth land in the high valleys and on the nearly flat broad divides of the high uplands cannot be reached by irrigation water either from present sources or from the irrigation system now being developed. Moreover, the supply of underground water beneath much of this land is inadequate for irrigation. Doubtless when economic conditions require the cultivation of these productive soils, now only useful for grazing, means will be found for irrigating them from distant reservoirs, which may be located in valleys and along streams north of the county.

Very small areas of upland soils are now farmed in the eastern part of the county by irrigation from pumped wells, as the Carrizo formation, which in many places is a good source of underground water, underlies some of this area.

Irrigation farming has been generally satisfactory in producing many kinds of crops. The most important vegetables produced for market are spinach and onions, but other vegetables and some feed crops are produced. Celery yields well, but it is not generally grown. It seems that the long growing season, the moderate climate, and good soils will lead to a general increase in irrigation farming as economic conditions warrant.

Records of the cost of privately operated irrigation projects are not available. In the Quemado Valley the cost of irrigation by gravity is calculated by adding the flat rate of $2.50 an acre to the service rate, which is $2 an acre for the first 15 inches of water used and $1 for each additional foot. Another item in cost of irrigation is the special tax, which includes interest and principal payments on the bonded indebtedness incurred in construction of the system. It is levied on an acre basis and grows less in accordance with the amount of annual liquidation, ceasing entirely when the bonds are retired. A hydroelectric plant purchases water from the district, thereby reducing the cost of irrigation to the farmers.

At present, no accurate record is kept of the quantity of water used for irrigating crops, but it is evident that some areas have been over-irrigated. The amount of water generally required for most crops is estimated as 3 to 4 acre-feet. The first irrigation requires 3 or 4 inches and successive waterings 2 or 3 inches each.

Two general methods of irrigating or applying water to the fields are in use. Large commercial farms that produce only one or two crops use the border method of applying water; but smaller farms that produce a diversity of crops favor the furrow method.

By the border method, parallel ridges about 6 inches high and from 12 to 15 feet apart are thrown up in the direction of the slope of the land. Field laterals are then laid out approximately at right angles to the borders but having sufficient fall to deliver the water freely without washing the soil. They are spaced at intervals of 150 to 200 feet. Water is introduced into the borders from the lateral at the upper side, and baffles of earth on either side and at right angles to the borders aid in spreading the water evenly. Seeding of spinach is done before the borders and laterals are constructed.

In the furrow method of irrigating, the land is prepared according to the regular ridge and furrow method of planting crops. The direction of the ridges and furrows, however, coincides sufficiently with the slope of the surface for water to flow gently along the furrows without washing the soil. The crop is planted on the ridge, and the field laterals are constructed at right angles similarly to those used in the border method.

Variations of both methods are designed to allow the irrigation of uneven or sloping ground. The main canals and laterals of all systems of the county are open ditches.

With the introduction of gravity irrigation, small areas of soils have been affected by a high water table, resulting in complete saturation of the soil by water. This condition is attended by a concentration of soluble salts in some of the soils. This has been produced by seepage from some sections of canals and laterals where they pass through very permeable soils, by the lack of thorough underdrainage of some soils, and by the use of excessive quantities of irrigation water in places.

Under natural conditions the soil, with the aid of vegetation and normal run-off through natural drainage systems, is able to absorb much of the precipitation that falls. Under irrigation, however, in addition to the normal rainfall, a quantity of water three or four times as great is added. As a result, the normal facilities for drainage become inadequate. Thus water enters the soil more rapidly than it can be accommodated or carried away, the water table rises rapidly until capillarity is established with the surface, and some of the excess water escapes by evaporation, allowing soluble salts to accumulate in the soil, some of which, especially in large amounts, are toxic to plants.

The saturated waterlogged condition denoting a high water table is evidenced by free water in the pits along the canals, roadside ditches, or other depressions and by the dark-colored moist surface soil in some fields. The installation of adequate drainage facilities, lining of canals to prevent seepage, and the judicious use of water in irrigation are methods required to overcome and prevent the formation of a high water table with its consequent injury to the soils.

Slow underdrainage in the heavy soils with clay subsoils allows excess water to remain in the soil. Free underdrainage in the sandy soils favors removal of most of the excess water, thereby preventing high water tables and excessive accumulations of salts. Proper care and use of irrigation water, however, should maintain satisfactory production on all the soils suitable for irrigation.

Table 7 gives the total soluble salts in samples of soils in the Quemado Valley.

TABLE 7.—*Content of soluble salts in samples of soils from the Quemado Valley, Maverick County, Tex.*[1]

Soil type	Depth	Parts per million	Soil type	Depth	Parts per million
	Inches			*Inches*	
Laredo loamy very fine sand	0–12	269	Laredo silty clay loam	0–12	515
	12–24	212		12–24	515
	24–36	206		24–36	850
	36–48	195		36–48	985
	48–60	350		48–60	770
	60–72	320		60–72	770
Laredo fine sandy loam	0–12	290	Uvalde silty clay loam	0–12	475
	12–24	309		12–24	606
	24–36	393		24–36	885
	36–48	496		36–48	749
	48–60	660		48–60	985
	60–72	698		60–72	3,050
Laredo very fine sandy loam	0–12	414	Uvalde clay	0–12	1,121
	12–24	373		12–24	1,332
	24–36	373		24–36	5,750
	36–48	414		36–48	8,000
	48–60	373		48–60	10,780
	60–72	345		60–72	10,000
Laredo loam	0–12	382			
	12–24	324			
	24–36	324			
	36–48	318			
	48–60	313			
	60–72	347			

[1] Analyses by Wheatstone bridge under direction of G. S. Fraps, chemist, Texas Agricultural Experiment Station.

These analyses indicate a low content of total soluble salts in the Laredo soils, especially those of sandy and medium textures. Although irrigation canals and laterals through these soils will probably allow considerable loss of water by seepage unless means are used to prevent this leakage, the soils have good underdrainage, and with ordinary care a high water table should not develop. It will be noted that the heaviest soil of the Laredo series has relatively the largest amount of soluble salts, indicating slower underdrainage. The Uvalde soils are heavier textured and older than the Laredo soils. Their total content of salts is high in some layers, indicating slow underdrainage and the necessity for careful use of water in soils that have heavy clay subsoils.

The character and quantities of salts (expressed in parts per million) in the different depths of the surface soil and subsoil of Uvalde clay are shown in table 8.

TABLE 8.—*Analysis of soluble salts in a sample of Uvalde clay from the Quemado Valley, Maverick County, Tex.*[1]

Depth (inches)	Carbonate of lime	Sulfate of lime	Carbonate of magnesia	Sulfate of magnesia	Carbonate of soda	Sulfate of soda	Chloride of soda	Total
	P. p. m.	*P. p. m.*	*P. p. m.*	*P. p. m.*	*P. p. m.*	*P. p. m.*	*P. p. m.*	*P. p. m.*
0–12	----------	----------	----------	----------	----------	----------	----------	636
12–24	195	----------	117	----------	241	59	223	835
24–36	173	----------	56	----------	154	689	1,907	2,979
36–48	248	177	----------	161	----------	1,687	2,302	4,575
48–60	195	1,285	----------	450	----------	2,515	1,964	6,409
60–72	184	----------	75	----------	28	1,103	1,861	3,251

[1] Analysis under direction of G. S. Fraps, chemist, Texas Agricultural Experiment Station.

It will be seen that of the salts injurious to plants, sulfate of soda and chloride of soda, are present far beneath the surface. Under excessive irrigation with inadequate underdrainage, these salts may be brought nearer the surface within the feeding zone of the root systems of plants.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of the environment acting on the soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) physical and mineralogical composition of the parent soil material; (2) climate under which the soil material has accumulated and existed since accumulation; (3) relief, or lay of the land, which determines the local or internal climate of the soil and its drainage, moisture content, aeration, and susceptibility to erosion; (4) biologic forces acting on the soil material—the plants and animals living on and in it; and (5) length of time the climatic and biologic forces have acted on the soil material.

Maverick County lies in the western part of the Rio Grande Plain of southwestern Texas, in a soil area designated as a part of the province of Reddish Brown soils.[18] Reddish Brown soils, however, occupy

[18] SOIL SURVEY DIVISION, BUREAU OF CHEMISTRY AND SOILS. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Yearbook (Soils and Men) 1938: 1019–1161, illus. 1938. See pp. 1092–1095.

only a small part of the county, as the prevailingly fine textured highly calcareous parent materials have given rise to gray rendzinalike soils in most of the county. The warm semiarid climate and grass-brush vegetation have influenced the development of the soils and given them certain distinctive characteristics, differing essentially from those of soils developed under greater or less rainfall. The chief distinguishing feature of the normal soils developed here is the accumulation of soft calcium carbonate in a subsoil horizon, a characteristic of the division of soils identified as Pedocals. The color of the soils ranges from light to dark, their content of organic matter and lime varies greatly, and only the soils developed on noncalcareous or slightly calcareous parent materials have the reddish-brown color and characteristic profile development of the Reddish Brown soils.

Local differences in soil characteristics and soil conditions are due, in a large part, to the different kinds of parent materials from which the soils have been developed. These consist of weathered materials of Upper Cretaceous, Eocene, Pleistocene, and Recent systems, including chiefly calcareous unconsolidated materials of shale, shaly clay, marl, and noncalcareous sandstone and sandy beds. Calcium carbonate and calcium sulfate are abundant in some of the formations. Differences in soil development are also due to variations in local surface features, drainage, and density and character of native vegetation.

Throughout much of the county the surface is smooth, so that soil development is undisturbed by severe erosion; consequently in such areas the soils are deep. Where local features of relief allow free drainage and rapid run-off of rain water, however, the soils are shallow and show only slight development. On the other hand, where a very smooth surface allows little or no run-off, local conditions favor the development of intrazonal soils comparable to soils normally developed under a higher rainfall east of this county.

The warm climate encourages a rapid thick growth of many kinds of plants where moisture conditions are favorable. Owing to a low and frequently irregular rainfall, the supply of moisture is not everywhere conducive to a heavy growth of grasses, and only the more hardy semidesert types of shrubs and other plants grow abundantly. These conditions have produced soils in which the organic-matter content is lower and the color is lighter than in soils developed under a higher rainfall and a more abundant growth of grasses. Moisture is not sufficient to leach completely the calcium carbonate from all layers of the soils, and large areas of soils, especially the heavy soils developed from calcareous parent materials, are rendzinalike. Only soils formed from siliceous parent materials, which also are characterized by a low content of calcium carbonate, develop a red color. These red soils are of very slight extent in this county, as the parent materials giving rise to them are not extensively represented here. The dominant soil color is gray, with shades ranging from very light to very dark, and there is not much brown in most of the soils.

Although the county lies in the Reddish Brown soils region, the strictly zonal reddish-brown soils are inextensive and occur mostly in the eastern part, where small outcrops of the Carrizo formation have developed into reddish-brown siliceous soils included in the Webb and Crystal series. Small areas of reddish-brown soils, mostly very gravelly soils, have formed in places on the gravelly plain of the Reynosa formation from old outwash plains alluvium.

The reddish-brown soil profile here consists of a brown surface horizon of a slightly red hue, which grades into dull reddish-brown or red heavier textured material. This, in turn, grades into a horizon of sandy clay ranging in color from red through pink or yellow to almost white and containing a soft calcium carbonate accumulation. Crystal fine sandy loam and Webb fine sandy loam are the most important and extensive soils of this division. They exhibit the most mature profiles of all the soils in the county and differ in that the Webb soil has a very definite heavy illuviated B horizon and the Crystal soil shows a more completely leached condition and less well defined illuviation in the B horizon.

Following is a description of a profile of Webb fine sandy loam, as observed on the Black ranch:

1. 0 to 10 inches, reddish-brown fine sandy loam with a single-grain structure. The reaction is about neutral but ranges from slightly alkaline to faintly acid.
2. 10 to 20 inches, reddish-brown fine sandy clay, cloddy when dry, very compact, and faintly alkaline.
3. 20 to 30 inches, a transitional layer of reddish-brown or brownish-red to red fairly compact fine sandy clay or clay loam. This material is sticky when wet, is calcareous in the lower part, and has infiltrations of brown material from above in root channels and cracks.
4. 30 to 54 inches, brownish-red calcareous fine sandy clay or clay loam, compact and sticky when wet, and containing soft lumps of calcium carbonate, indicating the horizon of accumulation.
5. 54 to 72 inches +, light-gray chalky fine sandy clay.

The soils that are most extensive and that also appear to reflect characteristically the dominant environment are grayish-brown or dark-gray calcareous soils developed from calcareous shales and sandstones, probably more or less interbedded in places. The Maverick series includes some of the lighter colored (brownish gray or grayish brown) soils of this group. They occur on smooth but freely drained surfaces under a rather light grass cover.

Following is a description of a profile of Maverick clay loam, as observed 3 miles northwest of the Old Indio ranch headquarters:

1. 0 to ¼ inch, a surface crust of calcareous yellowish-brown or brownish-yellow very fine sandy loam or silt loam. This material separates easily from the material below and cracks into irregular chips, two-thirds of an inch in diameter, that curl around the edges.
2. ¼ to 7 inches, grayish-brown clay loam with perpendicular cracks and easily crushed angular clods one-third inch in diameter, which, when dry, are moderately hard. The material is calcareous.
3. 7 to 17 inches, compact brownish-yellow sandy clay containing a few particles of small igneous rock gravel, one-fourth inch in diameter, and a trace of free calcium carbonate in soft white spots. The material contains perpendicular cracks, has a prismatic structure, and is calcareous.
4. 17 to 43 inches, yellow calcareous sandy clay that is more friable than the material above and contains much calcium carbonate in soft white lumps. Small lenses of thin platy sandstone fragments are present in the lower part. This is the horizon of lime accumulation.
5. 43 inches +, partly disintegrated calcareous sandstone.

Maverick clay differs from Maverick clay loam in being considerably heavier textured, as it has developed largely from calcareous shale or shaly clay. Maverick fine sandy loam differs from Maverick clay loam in being siliceous and much more permeable throughout, as all the horizons have been developed mainly or entirely from calcareous sandstone. The somewhat lighter colored Reagan soils and the Uvalde soils

have the same general color and characteristics produced by the factors of the environment. The former have developed from ancient alluvium on the high gravel and outwash plain of the Reynosa formation under a light grass vegetation and an accumulation of much calcium carbonate; the latter also have developed on old alluvium on very smooth surfaces but under a somewhat heavier grass cover and from deeper layers of fine earth than the Reagan soils, thereby developing into slightly darker and deeper soils. The Maverick and Reagan soils perhaps may be considered the normal zonal soils developed from calcareous parent materials, and the Uvalde soils possibly as intrazonal soils, which would be more characteristic of the subhumid region to the east. As all these brownish-gray soils are calcareous in all horizons from the surface down to and including the parent material, they also may be considered rendzinalike soils of the semiarid region.

Large areas of dark soils are included in the Monteola series. These soils are very dark gray or black, calcareous, and deeply developed on very smooth surfaces, under a relatively heavy grass cover, from deeply weathered calcareous shales of the Upper Cretaceous series of rocks. Their parent materials are about the same as those giving rise to Maverick clay, but they have developed under conditions of more moisture and a heavier grass cover, owing to the smoother surface and less run-off of rain water. These probably should be considered intrazonal soils in this county, but in the Reddish Chestnut soils region, which lies to the east, such soils are fairly common and possibly could be considered zonal. The smooth surface and slight run-off produce, locally, moisture conditions more representative of the Reddish Chestnut soils than of the Reddish Brown soils.

The normal general profile of the Monteola soils comprises (1) a heavy calcareous dark surface layer that gradually becomes less dark with increase in depth, giving way to (2) a gray calcareous layer that becomes lighter colored and somewhat yellow with depth and grades into (3) yellow calcareous soft chalky clay containing a large amount of white soft calcium carbonate consisting of the accumulation incident to the processes of soil development. This material passes into partly weathered calcareous shale.

Following is a description of a profile of Monteola clay, as observed 2 miles east of the intersection of the Uvalde and La Pryor roads:

1. 0 to 7 inches, black or very dark gray calcareous clay with a fragmentary structure and some granulation. On drying, the material separates naturally to small hard angular clods.
2. 7 to 24 inches, black or very dark gray heavy and dense calcareous clay with a prismatic structure and perpendicular cracks.
3. 24 to 35 inches, a transitional layer of mixed dark clay and gray calcareous somewhat compact silty clay with dark infiltrations from above along root channels and cracks, a prismatic structure, and perpendicular cracks.
4. 35 to 84 inches, pale-yellow or gray soft chalky crumbly calcareous clay containing much free calcium carbonate in white lumps and finely divided gypsum crystals in the lower part. This is the horizon of accumulation. The material grades into weathered calcareous shale.

Monteola clay has a hog-wallow relief, characterized by small shallow depressions a few feet wide intermingled with corresponding slight elevations. The profile sample described was taken in a depression where the soil is dark to a much greater depth than on the intervening elevations.

As the Monteola soils are calcareous throughout, they may be considered as dark rendzinalike soils of the semiarid and subhumid regions.

The Zapata series includes skeletal soils developed thinly over chalky calcareous beds. They occupy highly eroded areas where various parent soil materials, including calcareous sandstones, shales, and clays or thickly accumulated calcareous layers (caliche), lie exposed or very near the surface.

Alluvial soils, undifferentiated, comprise light-colored calcareous soil materials lying in the low first-bottom flood plain of the Rio Grande. The materials were transported by floodwaters from eroded soils of western uplands.

The Leona series includes very dark calcareous soils, along local small streams, consisting of sediments transported from dark soils of the nearby uplands.

The Laredo soils consist of brown or grayish-brown alluvial soils of high stream terraces of the Rio Grande Valley, which have undergone a slight soil development and acquired some characteristics of the regional environment. They are rarely overflowed.

Rough stony land and rough broken land represent land conditions produced by excessive natural or geologic erosion, and very little true soil development has taken place.

SUMMARY

Maverick County comprises an area of 1,278 square miles along the Rio Grande in southwestern Texas. It is in the semiarid western part of the Coastal Plain. The surface is smoothly undulating to gently rolling, with some steep eroded areas near the Rio Grande Valley. High temperatures, low rainfall, long hot summers, and short mild winters characterize the climate. The native vegetation consists largely of a more or less scattered growth of low thorny brush and small trees, with a thin cover of short nutritious grasses. The mesquite tree, a small tree of common occurrence throughout the Southwest, is dominant but more or less scattered.

The climate and vegetation favor the raising of range livestock on the native pastures. This enterprise has thrived for a long time, and more than 97 percent of the entire area still is thus used. The average carrying capacity of native pasture is reported locally as being about 18.25 cow-acre-days, or 20 acres per cow and calf unit a year. All pastures are fenced. The chief breed of cattle is the Hereford. Sheep and goats are raised also. Improved high-grade herds and flocks are maintained on most ranches.

Farming is carried on mainly in the Rio Grande Valley, principally under irrigation. For the most part, the soils farmed under irrigation are members of the Laredo and Uvalde series. Very small areas are farmed occasionally without irrigation. Soils of the Monteola and Webb series are used mostly in dry farming, but results are very uncertain. Cultivation is limited by the lack of water for irrigation and the slight demand for products that could be produced. Farming operations are concerned chiefly with growing vegetables and truck crops under irrigation, mainly spinach and onions, together with various others and some feed crops.

For discussion, the soils are placed in three groups: (1) Soils of high to moderate productive capacity, (2) soils of moderate to low productive capacity, and (3) miscellaneous soils and land types unsuited to cultivation. Not all the soils of the first group, and practically none of the second and third groups, are cropped. Most of the soils are smooth lying, deep, and fertile, but some are thin and eroded and occupy rougher or steeper areas.

The Monteola soils are extensive productive dark soils of two types—clay and clay loam. They occupy large areas of smooth uplands in the northern part of the county and are used entirely for pasturing range livestock on large ranches. These soils have no available sources of irrigation water at present and probably will be used only for range lands for a long time. They produce fairly good range forage.

The Maverick soils are extensive and occupy much of the undulating and rolling uplands. They are grayish brown and only moderately productive. They have practically no sources of water for irrigation and are used only for pasturing livestock. Certain soils of the series—mainly the clay loam and fine sandy loam types—probably would be rather productive under irrigation.

The Uvalde and Laredo soils where situated favorably for irrigation are used for producing cultivated crops under irrigation and are rather productive and well suited for many crops. They are smooth-lying deep fertile soils and in many places are readily accessible to irrigation water.

Some areas of shallow soils of the Zapata series and gravelly soils of the Reagan and Webb series, together with areas of rough stony land and rough broken land, comprise soils and lands unsuited to cultivation, as they are too thin and, in places, too severely eroded. They are used as livestock range, the scattered brushy growth providing browse and the very thin grass cover providing scanty grazing.

Maverick County is in the soil province of Reddish Brown soils, but most of the soils are calcareous, gray, and rendzinalike. Soil textures range from loamy very fine sand to clay, but heavy soils of fine textures predominate.

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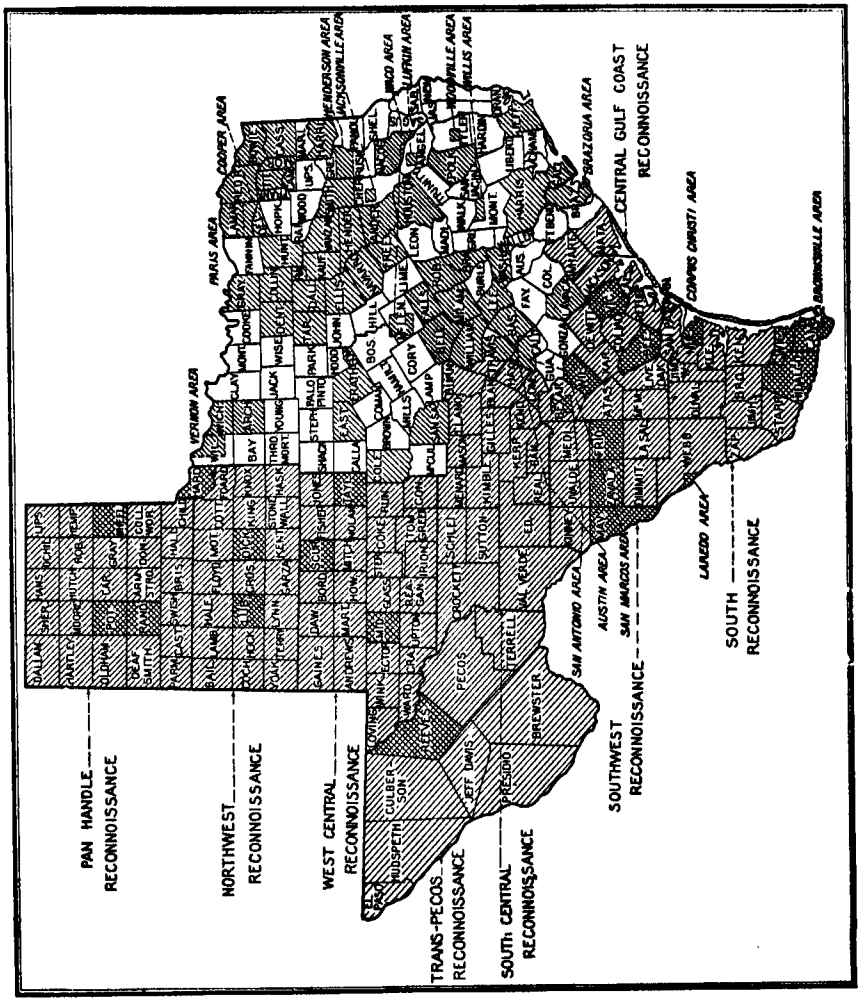

Areas surveyed in Texas, shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; crosshatching indicates areas covered in both ways.

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