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Soil Survey
of
The Fort Sumner Area New Mexico

By

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and E. N. POULSON

Bureau of Chemistry and Soils
In cooperation with the
New Mexico Agricultural Experiment Station

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SOIL SURVEY OF THE FORT SUMNER AREA, NEW MEXICO

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AREA SURVEYED

The Fort Sumner area includes a small part of De Baca County, in the east-central part of New Mexico. (Fig. 1.) The town of Fort Sumner, near the central part of the area, is about 120 miles directly southeast of Santa Fe. The area comprises 124 square miles along Pecos River, including practically all the irrigated lands of the county and also parts of the adjacent upland on both sides of the river valley.

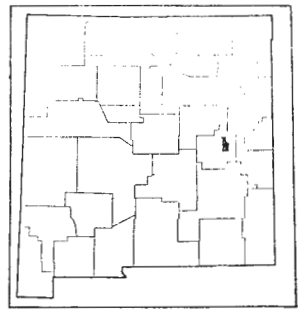


FIGURE 1.—Sketch map showing location of the Fort Sumner area, N. Mex.

The region as a whole is a broad nearly smooth southeastward-sloping plain. Toward the northeast, but beyond the Fort Sumner area, is a higher plain, the edge of which is marked by steep sharply defined escarpments. Drainage is toward the south through Pecos River.

The area surveyed includes a small part of this high plain, a lower-lying old alluvial flood plain near the river, and a narrow and lower more recent flood plain adjacent to the river channel. The old high plain has minor inequalities, caused largely by erosion both by water and wind. It is crossed by small intermittent streams, each in a broad shallow valley, through which the stream channel follows a deeply cut meandering course. Along the sides of these valleys the slopes are steep and in places badly eroded by small tributary streams. Erosion is more pronounced and the slopes are steeper near the points where the streams enter the valley of Pecos River. Many of the slopes have a thin capping of gravel, and in some places caliche or the underlying rock beds are exposed. In other places minor inequalities are due to wind erosion and the formation of sand dunes.

The old alluvial plain, which extends along Pecos River, is from 40 to 60 feet lower than the old high plain, from which it is separated by a fairly well defined steeper slope. This slope has, however, been modified and more or less obliterated by outwash material and windblown sand from the higher plain. The alluvial plain has a slight slope toward the river and also downstream, but its lower edge is not sharply defined, in most places being marked by one or more drops or benches from 4 to 8 feet in height. Fort Sumner, situated on the higher part of the old flood plain, is 3,960 feet above sea level.

The lower-lying more recently formed flood plain extends as a narrow belt along Pecos River. Much of it is only from 2 to 6 feet

higher than the channel of the river, but some parts are slightly higher. The river channel is broad, shallow, and not well defined. During flood stages the river has the appearance of a deep swift stream, but it subsides quickly and breaks into numerous narrow interlacing channels which thread their way between low, flat sand bars.

In places both the old flood plain and the more recently formed lower one are developed, but in other places the river channel has cut into the edge of the old high plain, leaving a perpendicular bluff ranging in height from 75 to 100 feet, such as that along the west side of the river 3 miles south of Fort Sumner.

This is a region of short-grass vegetation. On the "hard lands" of the upland plain grama and buffalo grass predominate, with a slight association of needle grass, curly mesquite grass, yucca or beargrass, broomweed, and, in low places where there is an accumulation of moisture, tobosa grass. Where the surface soil is loose and sandy, yucca is much more abundant than on heavier soils, and associated with it is bunch grass or sage grass. On extensive areas of loose sand, sage grass predominates and on other sand areas the predominant growth is one of the true sages. On very shallow and gravelly soils a low-growing coarse grass of little value is common. In the river valley the tall saccaton grass is common, and where alkali has accumulated salt grass predominates.

Large cottonwood trees grow in the valley, especially near the river channel or where they have been planted, and a dense growth of small salt cedar covers the low sandy stretches near the river channel and some of the low sand bars in the channel. Low-growing mesquite occurs in many places both on the uplands and in the river valley.

In 1862, a fort was established by General Carleton on the east side of Pecos River 5 miles south of the present site of the town of Fort Sumner.[1] The Bosque Redondo, 40 miles square and including about 6,000 acres of arable land, was laid out and a large number of Indians, many of whom were Navajos and some Apaches, were placed on it. In 1864–65 the number of Indians on this reservation was about 8,000. Irrigation ditches were constructed and considerable farming is said to have been carried on. It is said, however, that crops failed year after year and that the Indians lost their flocks and herds.[2] A road was built from the old fort, which is in the north-central part of sec. 15, T. 2 N., R. 26 E., on the east bank of Pecos River, to a point near the present site of Fort Sumner, and it was planted on both sides with cottonwoods. Although many of the old trees have been cut down in recent years, remnants of this old avenue are yet to be seen, the remaining trees being now very large and tall. (Pl. 1, A.)

Much of the irrigated land has been farmed almost continuously since the removal of the Indians from Bosque Redondo and the abandonment of the old fort in 1866.

Old residents state that during the period between 1905 and 1914 there was an influx of homesteaders to this area and that during

[1] TWITCHELL, R. E. THE LEADING FACTS OF NEW MEXICAN HISTORY. v. 3, p. 419. Cedar Rapids, Iowa. 1917.
[2] TWITCHELL, op. cit., v. 2, p. 429, 431–433. 1912.

this time homestead rights were filed on practically every quarter section of Government land in this immediate locality. Old Fort Sumner became a prosperous small town, as did also La Lande near the eastern limits of the surveyed area and Taiban a few miles farther east.

These settlers, however, soon found that a living could not be made from a homestead of unirrigated land, and as their resources were exhausted they sold their claims, to be used for range lands, and many of them left the country. Business in the small towns rapidly declined as the homesteaders abandoned their claims. The town of Fort Sumner was built near the railroad and when the county was organized became the county seat.

De Baca County was organized in 1917 from parts of Chaves, Guadalupe, and Roosevelt Counties. It has a total area of 1,536,000 acres, of which only 80,000 acres, or a little more than one-twentieth, has been included in the Fort Sumner area. This area, however, includes practically all the irrigated land of the county and much of that which might be brought under irrigation should a larger irrigation project be developed.

According to the Federal census, the population of De Baca County in 1930 was 2,893, this being 303 less than in 1920. Of this number, 839 people live in Fort Sumner and most of the rest in the irrigated section covered in the surveyed area.

In the Fort Sumner area approximately 5,000 acres are in the irrigated district, and in this part of the area the farm unit is small, many farms containing only 40 acres or less. This part of the area is thickly settled as compared with the unirrigated part. This is indicated on the soil map by the frequency of roads and number of houses.

In the unirrigated part of the area the population is very sparse, averaging only one family to several sections of land. One livestock rancher owns 30,000 acres, an area about five times as large as the entire irrigation district. Sparseness of settlement is shown on the soil map by scarcity of roads and trails and the small number of houses. Some of the houses shown on the map are not occupied but have been indicated for their value as landmarks.

The Belen cut-off of the Santa Fe Railway, completed in 1907, furnishes good railroad facilities. United States Highway No. 70, which crosses New Mexico from east to west, passes through the area, and New Mexico State Highway No. 20 crosses it from north to south. Both roads are well constructed and well maintained. Much freight and some passenger business is handled by truck and stage. An airport is located near Fort Sumner, and planes of the Transcontinental Air Transportation Co. pass this port on regular daily schedule. In addition to the highways numerous roads and trails cross the range lands, so that all parts of the area are well supplied with roads. Some of the trails have been carefully laid out and stretch across the plains for miles without crook or turn. One of them extends from State Highway No. 20 northeast across the northern part of the area and far beyond it.

A consolidated high school at Fort Sumner affords good educational facilities for the greater part of the area, and the neighboring community is well supplied with all modern conveniences of both

farm and home. Except for its isolation, this small community living on the irrigated farms differs but little from a highly developed enlightened community in any other part of the United States. A large part of the community is engaged in, or interested in, the growing of fruits, alfalfa, sweetpotatoes, melons, and other truck and garden crops. Many of the people are interested in a small way in dairying and poultry raising.

On the unirrigated lands livestock raising is conducted on a large scale. The livestock includes both cattle and sheep, cattle predominating. All range lands are fenced, some with coyote-proof woven-wire fences.

CLIMATE

The Fort Sumner area lies in the high-plains region. The air is clear and the percentage of sunshine high, ranging from 70 to 80 per cent of the possible amount. Humidity is low, ranging from 48 to about 52 per cent. This is much lower than that of Kansas City, which is 64 per cent; of Chicago, which is 74 per cent; or of San Francisco, which is 80 per cent. For this reason the same degree of heat or cold is not felt so keenly as in a region of higher humidity.

Precipitation is principally in the form of local showers. The heaviest rainfall normally occurs during July and August. Snowfall is light, averaging 12.3 inches annually. Evaporation is high, being more than 65 inches annually at the Santa Fe field station. The mean annual temperature is 57.7° F.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Fort Sumner, De Baca County, N. Mex.*

[Elevation, 3,960 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1867)	Total amount for the wettest year (1919)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	37.1	79	−8	0.95	1.24	2.06	3.9
January	38.3	78	−22	.42	.23	.12	2.6
February	42.8	81	−4	.55	.00	.36	.9
Winter	39.4	81	−22	1.92	1.47	2.54	7.4
March	48.8	88	7	.97	.97	6.79	.7
April	56.5	94	14	1.06	.43	3.41	.9
May	65.6	99	32	1.51	.54	2.20	(1)
Spring	57.0	99	7	3.54	1.94	12.40	1.6
June	75.3	109	40	1.85	.70	5.37	0
July	78.2	106	46	2.27	.80	2.26	0
August	76.6	106	49	2.50	.50	1.18	0
Summer	76.7	109	40	6.62	2.00	8.81	0
September	69.3	100	34	1.37	3.15	4.27	0
October	57.5	92	17	1.41	.70	.92	(1)
November	46.7	86	−11	.78	0	1.57	3.3
Fall	57.8	100	−11	3.56	3.85	6.76	3.3
Year	57.7	109	−22	15.64	9.26	30.51	12.3

[1] Trace.

The average date of the last killing frost is April 12 and of the first is October 23, giving an average frost-free season of 194 days. Killing frost has been recorded as late as April 26 and as early as October 9. Injury to fruit from late frosts in the spring occurs occasionally, but frost damage is reduced to some extent by the use of smudges in the better orchards.

Table 1, compiled from records of the United States Weather Bureau station at Fort Sumner, gives the more important climatic data for the area.

AGRICULTURE

According to the 1930 Federal census, De Baca County has 352 farms, a decrease of 125 since 1920. Of this number, 86 have an area of less than 100 acres, and 136 have an area of more than 1,000 acres each. The percentage of farms operated by owners or part owners is 76.1; by tenants, 23; and by managers, 0.9.

The value of farm lands and buildings in 1930 was $3,538,175, or an average of $10,052 a farm, and the average acre value of land and buildings was $2.32.

The total number of horses in the county in 1930 was 3,548; of mules, 562; of cattle, 30,526; of sheep, 65,857; of goats, 1,773; of swine, 558; and of chickens, 15,322.

The total value of field crops, orchard crops, and vegetables in 1929 was $185,047. The value of dairy products, excluding those used at home, was $46,828; of wool produced, $120,817; of eggs, $29,235; of chickens, $16,560; and of turkeys, $10,355.

The total acreage of corn in 1929 was 2,012 acres, of which 1,798 acres were harvested for grain, yielding 48,959 bushels; 12 acres were cut for silage, yielding 32 tons; 182 acres were cut for fodder; and 20 acres were hogged off.

Farms of this area may be divided into two groups—irrigated farms and livestock farms or ranches. The irrigated farms are as a rule small, the farm unit being about 40 acres, although some are larger. The livestock ranches each include many hundred acres, some of them several thousand acres, of fenced grass or range land. On these large ranches practically no cultivated crops are grown. A ranch house is maintained, and wells equipped with windmills supply water. Men look after the fences, water supply, and cattle. Range riding is done largely with automobiles.

On the small irrigated farms the owner and his family, or a tenant, live on the farm and carry on general farming, fruit and vegetable growing, dairying, and poultry raising. On most farms several different lines of farming are carried on. This kind of farming has gradually developed since the region was first settled.

On the small farms all available manure from work animals and from dairy cows is utilized, and in recent years a rather large quantity of commercial fertilizer is being applied annually. Through experiments carried on by the State College of Agriculture it was shown that applications of fertilizer high in phosphates gave profitable increase in yields of alfalfa, and during the last season, 1929, about 100 tons of 18 per cent superphosphate was applied. The greater part of this was used on alfalfa, drilled in or broadcast before the first cutting, at a rate ranging from 200 to 280 pounds an acre. Most of the manure is used on alfalfa land.

Irrigated farms are for the most part operated by the owners, the work being done largely by the owner and his family. Monthly wages for hired labor were about $50 in 1929, either with board or with a house and garden furnished, and for day labor from $2 to $2.50. Much of the day labor is performed by Mexicans who live in Fort Sumner.

Equipment on the irrigated farms consists for the most part of a medium-sized house, small barn, and other outbuildings, barbed wire and some woven-wire fence, and the necessary farm machinery. Tractors are used on some farms, but the greater part of the farm work is done with horses.

In the irrigated part of the Fort Sumner area the growing of alfalfa, apples, grapes, sweetpotatoes, corn and other row crops, and the production of dairy and poultry products are the principal industries. On the dry lands the raising of cattle, mainly Herefords, is the most important industry. Some dairying is carried on, with Holstein-Friesians and Jerseys the principal breeds of dairy cattle. A good many sheep are raised, and they are ranged principally along Pecos River where salt grass and saccaton are the principal grasses. Bees are kept to a small extent.

The crop of first importance on the irrigated lands of the Fort Sumner area is alfalfa. According to a State bulletin [3] alfalfa prefers a deep calcareous well-drained fertile soil. It does well when planted on a reasonably porous soil where the water table is within 4 feet of the surface and on some soils where it is even closer, provided the water level is maintained or is lowered slightly during the growing season, but even a slight rise at this time may prove injurious to the stand. On most irrigated valley soils the deep roots reach the water table or the saturated soil just above it and spread out, thereby suffering no damage. On the other hand, an old stand will decrease rapidly in density and yield if the water table rises on the roots, owing to the decay of the taproot.

All soils of this area are well supplied with lime. They are sufficiently open and porous for good aeration and plant growth, and most of the areas are productive. In places, however, the depth to the water table is not sufficient and the tendency during the growing season is toward a rising rather than a falling water table. The remedy consists in a more sparing use of water and in providing better underdrainage.

After seeped land has been drained it should be cultivated and planted to crops as quickly as possible. For this purpose alfalfa is the most profitable crop if a stand can be obtained. If it can not be, sweetclover, which is more resistant to alkali, may be used. Rotation of crops in which alfalfa is allowed to stand from three to five years only is recommended. Cultural methods in the irrigated lands are good.

The following recommendations, based on experiments at the Tucumcari field station, are believed to be generally applicable to farming the dry lands in De Baca County.[4]

Dwarf varieties of sorghums and broomcorn are better adapted to the soils of the area than standard types. Dwarf yellow milo is

[3] QUESENBERRY, G. R. ALFALFA. N. Mex. Agr. Expt. Sta. Bul. 139, 19 p., illus. 1923.
[4] BURNHAM, D. R., and CLEMMER, H. J. CROP PRODUCTION AT THE TUCUMCARI FIELD STATION. N. Mex. Agr. Expt. Sta. Bul. 176, 42 p., illus. 1929.

the most popular grain sorghum for grain production. Corn yields less than milo or kafir. Sumac has proved to be the best forage sorghum under trial. Broomcorn is a profitable crop, and the stalks aid greatly in preventing soil blowing. Cowpeas produce a high quality of hay, and their growth benefits succeeding crops. Pinto beans yield a fair return. The best time for planting grain sorghums, cowpeas, and beans is between May 15 and June 20. Soil blowing can be controlled to a great extent by cultural methods. Sand hills or very rolling land should not be farmed, and, when used for grazing, such areas should not be heavily stocked.

SOILS AND CROPS

The irrigated part of the Fort Sumner area includes only the soils of the old alluvial plain, classed as Winslow soils, and higher parts of the lower-lying more recently deposited Gila soils. This is due to their lower position, near the river, where they can be more readily reached by irrigation water rather than to their special fitness for irrigation. They are, however, on account of the naturally nearly smooth surface on which they lie, their slight slope toward the river and down the valley, and especially their good underdrainage, the best soils of the region for successful irrigation farming. With only few exceptions they have sandy or light loamy surface soils with heavier subsoils. For this reason they are easy to cultivate, and they take up moisture readily. The heavy subsoil holds large quantities of moisture but also releases it as needed by growing crops. In spots here and there, especially along the edges of low terraces, varying quantities of stream gravel are present on the surface and in the shallow subsoil. In places the gravel contains a large proportion of lime. The soils as a whole, however, are rather uniform, as indicated by the nearly perfect stand and uniform size of the trees in the better apple orchards.

Of the soils of the Winslow series the heavier grades of the fine sandy loam and the loam types are the most satisfactory for alfalfa, sweetpotatoes, melons, and all crops requiring intensive cultivation. The clay and clay loam types are rich, productive soils but are more difficult to cultivate, require greater care in handling the irrigation water used, and as a whole, are not quite so satisfactory as the soils of somewhat lighter texture. On the other hand, the soils with very loose surface sand at times blow badly and are not so easily irrigated as are the more stable soils.

The very fine sandy loam of the Gila group of soils, where it is deep and well drained, does not differ materially from the lighter soils of the Winslow series. As a whole there is, on account of the higher water table, more danger from the accumulation of alkali.

Crop yields on the soils named above are nearly uniform. Variations from normal are due quite as much to the methods of handling and abundance of moisture as to the inherent properties of the soil.

On the irrigated farms alfalfa is the most important crop.[5] (Pl. 1, B.) It is ordinarily cut four times, and the yield averages about 4 tons a season. The second crop in importance is fruit. Apples are the most widely grown fruit, about 900 acres being planted to

[5] Data supplied by county extension agent.

apple trees. (Pl. 2, A.) Jonathan, Delicious, Black Ben, Stayman Winesap, and other varieties are grown. The yield is variable but averages about one carload to the acre. Some recent plantings of apple orchards have been made. There are a few peach orchards (pl. 2, B), but as a rule they are not profitable. Grapes are at present grown on about 50 acres, and several new plantings have been made recently. They are at present considered one of the most profitable crops grown. Much of the fruit is sold to the people of the surrounding dry-land regions, in which fruit can not be grown.

The third crop in importance is sweetpotatoes. These yield from 150 to 200 bushels an acre, and a large part of the crop is stored for winter and spring markets.

Corn ranks fourth in importance, and yields of 50 or more bushels an acre are reported. Other important crops are cantaloupes, watermelons, tomatoes, and beans. The average returns for these crops range from about $50 to $75 an acre.

The price for the better grades of well-improved irrigated land ranges from $100 to as high as $250 an acre. The better orchards bring from about $200 to $300 an acre. The better grades of dry land range in price from about $5 to $10 an acre, and the sandy, broken, and eroded lands sell for less.

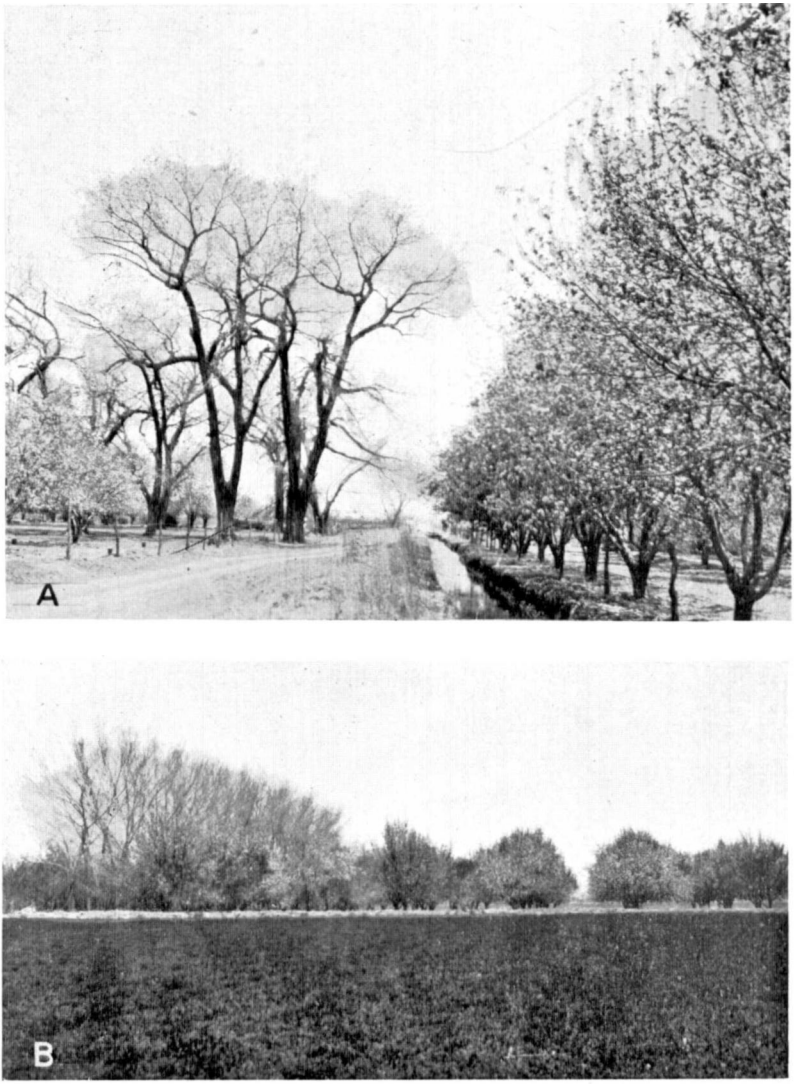
Of the range lands, the fairly heavy fine sandy loam in which the caliche has a soil covering of 30 or more inches is considered the best. This soil produces a good heavy grass growth in which grama and buffalo grass predominate. On such land but little yucca, or beargrass, grows. These areas are known as "hard lands." They furnish the most forage and are also the best suited for dry farming. Although practically no dry-land farming is carried on within the area surveyed, much is done in De Baca County outside the area. The principal crops grown on the hard lands are nonsaccharine sorghum, corn, and sorgo, in the order named.

The Fort Sumner area lies in a region where the soils range from reddish brown to red. According to stage of development they may be divided into the following three groups: Soils with a highly developed lime or caliche layer, soils with a partly developed layer of lime accumulation, and soils without such development.

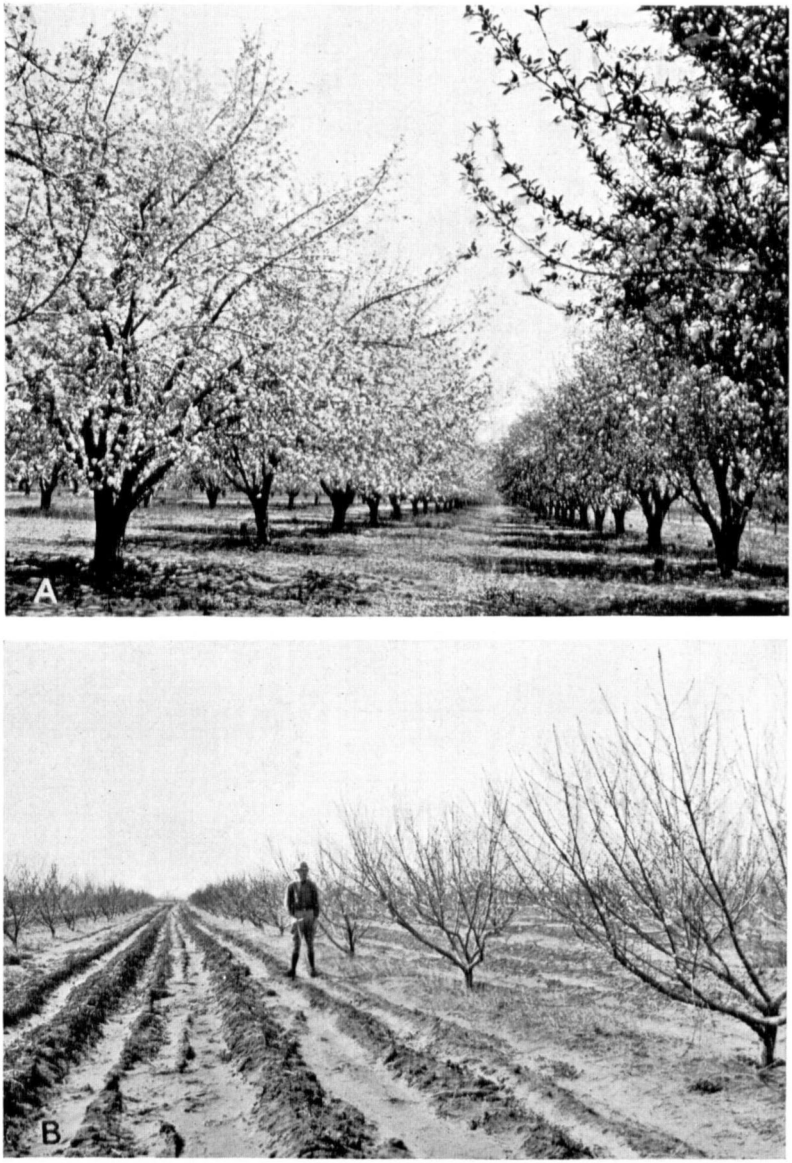
In the following pages the soils of the area are described in detail and their agricultural possibilities are discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are given in Table 2.

TABLE 2.—*Acreage and proportionate extent of soils mapped in the Fort Sumner area, N. Mex.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Springer fine sandy loam	30,656	38.6	Winslow loam	1,792	2.3
Springer fine sandy loam, rolling phase	10,240	12.9	Winslow clay loam	448	.6
Springer loamy fine sand	11,840	15.0	Winslow clay	1,600	2.0
Springer loamy fine sand, rolling phase	2,240	2.8	Gila very fine sandy loam	3,200	4.0
Springer fine sand	5,184	6.5	Gila fine sand	1,024	1.3
Springer fine sand, rolling phase	3,008	3.8	Gila loam	576	.7
Winslow fine sandy loam	4,416	5.6	River wash	1,216	1.5
Winslow loamy fine sand	1,920	2.4	Total	79,360	



A, Large cottonwoods along the avenue leading from old Fort Sumner; B, alfalfa on Winslow fine sandy loam, with apple orchard and windbreak of poplar in the background



A, Apple orchard on Winslow fine sandy loam; B, young peach orchard on Winslow fine sandy loam

SOILS HAVING A HIGHLY DEVELOPED LIME LAYER

Soils of this group range from reddish brown to brick red in color, are sandy in the surface soil, are rather distinctly heavier in the subsoil, and are underlain at widely different depths by nearly white fairly hard caliche of great thickness. In most places some rounded waterworn gravel occurs on the surface and through the surface soil and subsoil. It is most abundant on the steeper slopes bordering the valleys and in places lies almost directly on the caliche. Such areas have been outlined on the soil map as rolling phases, the more shallow and gravelly areas being indicated by rock-outcrop and gravel symbols.

West of Pecos River large areas have been indicated as rolling phases, because they are less well suited to irrigation than the more nearly level lower-lying land adjacent to the river valley. Here the slopes are not so steep, the soil is deeper, and there is less gravel and fewer exposures of caliche than in the rolling phases bordering the arroyos in the northern part of the area. These separations of rolling phases were not made in the field during the progress of the field work but afterwards in the office and are only approximately correct.

The caliche is hardest at its top where a very hard thin layer has formed. In places, especially on slightly higher ridges, the caliche has but a slight soil covering. In other places, especially where the soil is so loose and sandy that it blows into dunes and ridges, it has a covering several feet thick. On the main part of the nearly level uplands it is usually reached at a depth ranging from 24 to 30 inches.

These soils, which have been identified as members of the Springer series, occupy the uplands of the Fort Sumner area and extend far beyond it both to the east and west. Three members of this series, the fine sandy loam, loamy fine sand, and fine sand, have been recognized. All have rolling phases.

Springer fine sandy loam.—The following description of a sample of Springer fine sandy loam, taken in sec. 29, T. 4 N., R. 26 E., 5 miles north of Fort Sumner, is representative of this soil:

From 0 to 1½ inches, a dark slightly reddish brown or brown finely granular very slightly crusted surface mulch.
From 1½ to 10 inches, dark slightly reddish brown fine sandy loam which shows a slight cloddy structure but is easily broken. This layer is well filled with fine grass roots.
From 10 to 18 inches, distinctly more reddish brown fine sandy loam or light loam. The material in this layer shows a slight cloddy structure with vertical cleavage, but the clods are easily broken.
From 18 to 28 inches, lighter reddish-brown light loam with a slight coating of white along the cleavage planes and containing small white specks. This material is very easily crumbled.
From 28 to 32 inches, nearly white caliche which is hardest at the top of the layer but can be easily broken with a pick.

On a bluff 2 miles southwest of this point, caliche several feet thick is exposed.

This soil as a whole is rather uniform but has some variations. Near the edge of the Pecos Valley and the valleys of the smaller streams of the area it is not so deep and in places contains rather large quantities of waterworn gravel. In places caliche is exposed at the surface or has but a very thin soil covering. The more exten-

sive of these spots are indicated on the soil map by gravel symbols. In other places, away from the valleys, there are low ridges or mounds on which the caliche is covered by a very few inches of soil. In general the caliche is more highly developed and nearer the surface on the higher flat areas than on the lower-lying areas near the streams. On the west side of Pecos River, south and southwest of the site of old Fort Sumner, a belt of this soil, which is deeper than the higher-lying soil, extends along the river valley immediately above it. This belt is limited on the west by a well-defined steeper slope or slight escarpment. The lower belt really represents a very old stage in development of the valley, and in it the soils are somewhat younger than on the higher level plains. In the vicinity of La Lande and extending from United States Highway No. 70 to Taiban Creek is another area in which Springer fine sandy loam is not only slightly deeper but also brighter red or deeper red in color. Here the land supports a scattered growth of mesquite.

On Springer fine sandy loam grama and buffalo grass are dominant, and there is only a scattered growth of yucca. Other grasses, as burro, curly mesquite, and in places tobosa, are found. Where the soil has been closely pastured or has been under cultivation, needle grass and broomweed become established. In places there is a heavy growth of mesquite.

Springer fine sandy loam, rolling phase.—The rolling phase of Springer fine sandy loam differs from the typical soil in being less uniform in depth, in having areas of very shallow soil in which the caliche is exposed at the surface or has only a shallow soil covering, and in having a more uneven surface which renders the soil less well suited for irrigation. Narrow belts of this soil extend along the arroyos in the northern part of the area and along the edge of the upland which borders the river valley on the east. In this belt gravel is more abundant than in other parts of the area. West of the valley are areas of undulating soils less well suited for irrigation than those in the lower belt nearer the river. These have also been included with the rolling phase.

Springer loamy fine sand.—This soil differs from Springer fine sandy loam in having a surface layer, from 6 to 10 inches thick, of loose fine sand or loamy fine sand, but below this the soil is typical of the Springer series.

On Springer loamy fine sand yucca is much more abundant than on the fine sandy loam, and there is a scattered growth of bunch grass or sage grass.

Except a few gardens irrigated from wells, none of this soil within the area surveyed is irrigated. A very small proportion of it is dry farmed. Its principal use is as range land for livestock, mainly cattle. This soil produces a good grass growth.

It is believed that under irrigation the deeper, better parts of this soil would prove productive and well suited to all the crops commonly grown in this region. Trees once well started on this soil under irrigation, continue to live without irrigation, but their growth is very slow.

Springer loamy fine sand, rolling phase.—In the southwest part of the area a small body of Springer loamy fine sand having an uneven or rolling surface has been separated in mapping from the more

nearly level part adjacent to the river, and it is designated as a rolling phase.

Springer fine sand.—Springer fine sand consists of reddish-brown loose fine sand to a depth of about 10 inches. A thin surface mulch is not present in most places, owing to frequent shifting of the surface soil. Below a depth of 10 or 12 inches is reddish-brown loamy fine sand which tends to become more loamy and sticky with increasing depth. Below an average depth of about 24 inches this loamy fine sand contains small white specks and in places spots of lime accumulation. At an average depth of about 3 feet, but subject to wide variations, the white hard caliche is reached.

This soil differs from Springer fine sandy loam in having a more uneven surface, in places marked by well-developed dunes and areas of loose blow sand, in having much greater variation in depth to caliche, and in having a markedly different natural vegetation.

The following description of a sample of Springer fine sand taken from a cut along State Highway No. 20 in sec. 6, T. 2 N., R. 26 E., 3 miles southwest of Fort Sumner, is representative of this soil:

From 0 to 10 inches, reddish-brown loose fine sand not crusted at the surface.

From 10 to 24 inches, reddish-brown loamy fine sand, the red color being more pronounced than in the surface layer. This layer becomes more loamy with increasing depth and in the lower part contains a few specks of caliche.

From 24 to 30 inches, reddish-brown loamy fine sand containing small specks and spots of caliche and lime accumulation.

Below a depth of 30 inches, nearly white caliche, very hard at the top but softer and somewhat stratified below.

Vegetation on this soil consists very largely of yucca, or beargrass, and sage grasses. In places it also supports a thick growth of one of the true sages. In places there is a scattered growth of grama, broomweed, and mesquite. Nearly all this land is uneven or rolling and is therefore not well suited for irrigation.

This soil is used entirely as range land. The quantity of forage which it supplies is not so large as on the fine sandy loam, but it comes on earlier in the spring and for this reason is preferred by some stockmen.

The largest area of this soil lies between State Highway No. 20 and the valley of Pecos River south of Fort Sumner. A body is in the northeast corner of the area, and another is north of United States Highway No. 70, a mile west of La Lande.

Springer fine sand, rolling phase.—The rolling phase of Springer fine sand differs from the typical soil in having a very uneven surface and widely varying depth to caliche. It includes areas of sand dunes and intervening depressions which have been scooped out by the wind. The soil, as a whole, is unsuited for irrigation and is of rather low value for range land.

SOILS HAVING A PARTLY DEVELOPED LIME LAYER

Soils of the second group, the Winslow series, are characterized by their reddish-brown or deep brick-red color, by a subsoil which is markedly heavier in texture than the surface soil, by the accumulation of lime in light-colored irregular spots in the lower part of the subsoil, and by waterworn gravel in the deep subsoil, in many places occurring below a depth of 5 feet.

The Winslow soils have developed largely from old river deposits which have become well weathered and have been modified by deposition on the surface of material carried by both water and wind from higher-lying areas.

These soils slope gently from the foot of the slight escarpment which limits the valley to the flood plains of Pecos River. In places, especially along their lower slopes, they are marked by slight drops of only a few feet, the edge of the upper bench being gravelly or having gravel deposits near the surface.

On account of their position and also because they are well suited for the purpose, these are the principal irrigated soils of the area. Where uncultivated they support a growth of grama and buffalo grass, mesquite, some yucca, broomweed, needle grass, and a few other shrubs and plants.

Winslow fine sandy loam.—Winslow fine sandy loam is the most extensive soil of this group. It occupies the higher outer edge of the terrace and the better-drained parts nearer the river. The following description of a sample of this soil, as seen in an exposed cut near the center of the north side of sec. 34, T. 3 N., R. 26 E., 3 miles southeast of Fort Sumner, is representative of the soil as a whole:

From 0 to 1 inch, a brown or reddish-brown thin surface mulch not perceptibly crusted and containing a small quantity of waterworn gravel.

From 1 to 10 inches, reddish-brown fine sandy loam which breaks from the exposed bank in irregular clods, 2 inches or more in diameter. The clods, however, are easily crumbled. This layer also contains a few small gravel, and grass roots are abundant.

From 10 to 20 inches, dull reddish-brown fine sandy loam which is slightly heavier in texture than the surface layer. The material contains a few small lime-coated gravel and breaks into irregular clods which crumble easily.

From 20 to 30 inches, light reddish-brown or light brick-red soil with abundant small nearly white spots of lime accumulation from one-fourth to one-half inch in diameter.

From 30 to 48 inches, light reddish-brown medium or fine micaceous sand which extends to a depth of more than 60 inches.

Winslow loamy fine sand.—Winslow loamy fine sand differs from Winslow fine sandy loam in having a surface covering of loose fine sand from 6 to 12 or more inches thick. This covering is of recent origin and is the result of both wind and water deposition. The soil extends as a belt along the outer northern edge of the Pecos Valley, from Fort Sumner eastward. In this part of the area it consists largely of sand carried down and deposited by small arroyos. In other places, especially west of Pecos River, are areas of sand blown into the valley from the uplands.

Winslow loam.—Winslow loam differs from Winslow fine sandy loam principally in texture. This is due in part to lack of establishment of such thorough drainage and in part to deposition of slightly heavier soil material. The color is also slightly darker reddish brown, owing to a higher content of organic matter.

Following is a description of a sample of this soil, as seen in a deep excavation near the southwest corner of sec. 27, T. 3 N., R. 26 E., 2 miles southeast of Fort Sumner:

From 0 to 1 inch, a reddish-brown slightly crusted surface mulch.

From 1 to 10 inches, reddish-brown light fine-textured loam which breaks into large irregular clods from 2 to 13 inches in diameter. The clods crumble fairly easily. Plant roots are abundant in this layer.

From 10 to 18 inches, dark reddish-brown heavy loam which breaks into hard irregular clods.
From 18 to 30 inches, brighter, slightly purplish, red heavy loam or clay loam. When dry this material breaks into very hard large irregular clods, and when wet it is plastic. Small white spots of lime accumulation occur in this layer but less abundantly than in the corresponding layer of Winslow fine sandy loam.
From 30 to 36 inches, reddish-brown light loam or heavy sandy loam. A few small spots of lime accumulation and some lime-coated gravel occur in this layer. A heavy bed of gravel lies at a depth of about 60 inches below the surface.

Winslow clay loam.—This soil differs from Winslow fine sandy loam and Winslow loam in having a heavier texture, due partly to further breaking down of the soil as a result of less well drained conditions and partly to deposition of heavy material.

The following description of a sample of Winslow clay loam, as seen in a roadside cut of virgin soil near the center of sec. 34, T. 3 N., R. 26 E., 2½ miles southeast of Fort Sumner, is representative of the soil as a whole:

From 0 to 1 inch, reddish-brown finely granular fine sandy loam which is moderately crusted.
From 1 to 10 inches, reddish-brown clay loam which, where exposed to weathering, breaks into hard clods from one-half to 1 inch in diameter. A great many plant roots occur in this layer.
From 10 to 20 inches, dark reddish-brown or purplish-brown heavy clay loam. On exposed weathered surfaces the material breaks into somewhat regular hard clods about 1 inch in diameter.
From 20 to 30 inches, reddish-brown heavy clay loam of massive structure. A few small white lime spots and small lime-coated gravel occur in the lower part of this layer.
From 30 to 36 inches, reddish-brown light loam or fine sandy loam containing lime-coated gravel.
Gravel is more abundant below a depth of 36 inches.

Winslow clay.—Winslow clay differs from the other Winslow soils in that it is of very much heavier texture, deeper-red color, and more refractory to cultivate. It is the product, in part, of an advanced stage of breaking down of the soil particles as a result of deficient drainage, but most of it is developed from heavy material washed into the valleys and deposited there. The following description of a sample of virgin Winslow clay, taken in a deep roadside cut near the southwest corner of sec. 2, T. 2 N., R. 26 E., is representative of this soil. In an adjacent cultivated field the clods are large and hard.

From 0 to 1½ inches, dull reddish-brown well-crusted finely granular mulch, in which the small particles are angular.
From 1½ to 10 inches, dull reddish-brown clay breaking, where exposed to weathering, into hard somewhat cubical clods about 1 inch in diameter. Grass roots are abundant in this layer.
From 10 to 20 inches, dull reddish-brown clay which breaks into large irregular hard clods about 2 inches in diameter.
From 20 to 30 inches, dull-red massive clay. Lime spots in this layer are less abundant than in the corresponding layer of Winslow fine sandy loam.
From 30 to 48 inches, slightly reddish brown loam which becomes lighter in texture and more gravelly with increasing depth.

Several small areas of this soil have developed in the valley of Pecos River. One of these, which lies 3 miles south of old Fort

Sumner, is low and poorly drained and is more nearly like the Gila soils than soils of the Winslow series, but on account of its heavy texture has been included with the Winslow soils. A small area extends along Taiban Creek, 4 miles south of La Lande, and a small area of heavy poorly drained upland in sec. 12, T. 2 N., R. 26 E. has also been included.

SOILS HAVING NO LAYER OF LIME ACCUMULATION

The soils of this group, the Gila soils and river wash, differ from those of the second group in that they are grayish brown or slightly grayish red, in the absence of a zone of high lime accumulation, and in having, in general, a high water table. In many places in the subsoil is a thin layer of dark-brown or nearly black soil, and extensive areas have an accumulation of alkali in the surface soil.

Gila very fine sandy loam.—Gila very fine sandy loam is the only member of this group which is extensively cultivated in the Fort Sumner area. The following description of a sample of this soil, taken from a deeply cut river bank in sec. 33, T. 3 N., R. 26 E., 3 miles southeast of Fort Sumner, is representative of the higher, better-drained areas of this soil:

From 0 to 1 inch, light-brown or slightly reddish brown finely micaceous very fine sandy loam which is laminated and slightly crusted.

From 1 to 12 inches, brown finely micaceous very fine sandy loam which is thinly stratified with white irregular specks in the lower part of the layer.

From 12 to 18 inches, dark grayish-brown thinly stratified silt loam containing white alkali specks and bands along old root channels. The material is darkest at the top of the layer. The transition from the above layer is abrupt, and the soil grades with depth into slightly reddish brown material.

From 18 to 36 inches, brown or slightly reddish brown fine-textured loam. In exposed banks this material forms hard irregular clods and shows a slight vertical cleavage. A few white specks of alkali accumulation are present in this layer.

From 36 to 48 inches, reddish-brown light-textured fine sandy loam containing some small rounded gravel.

The higher, better-drained parts of this soil are under cultivation and are fairly productive. Such areas, although correlated as Gila soils, really represent a stage of development intermediate between the low-lying recently deposited soils and the higher more completely weathered soils of the Winslow series.

Gila fine sand.—Gila fine sand is light-brown or slightly reddish brown fine sand. Much of it has been blown into dunes and ridges and in places has encroached on cultivated fields. In other places it has been blown off, exposing small areas of waterworn gravel. Where blown into the cultivated fields some of this sand has been leveled and cultivated, and some areas support a growth of grass, but as a whole the soil is of low agricultural value.

Included with this soil as mapped are nearly level areas of shallow recent deposits of fine sand and very fine sandy loam 12 inches or less deep, underlain by river sand and having a high water table. These areas differ but little from river wash, but they support a growth of salt cedars and salt grass. Such areas furnish some forage but are not suitable for tillable crops.

Gila loam.—Gila loam occupies a few small areas in the lower part of the Pecos Valley. Small areas were at one time under cultivation, but at present all the soil is used as grassland. Parts of it contain rather large quantities of alkali and support a growth consisting almost entirely of salt grass.

The following is a description of a representative sample of Gila loam taken in sec. 26, T. 2 N., R. 26 E., on the Maxwell ranch. Here salt grass is the predominant growth. Small bare spots well crusted with alkali occur here and there. The water table lies at a depth of about 18 inches.

From 0 to 1½ inches, dark grayish-brown finely granular loam well crusted with white alkali.

From 1½ to 10 inches, dark-brown light-textured loam grading into heavier material with increasing depth. This layer contains white specks of alkali accumulations.

From 10 to 24 inches, slightly lighter brown or more reddish brown loam which is saturated below a depth of 18 inches.

From 24 to 36 inches, dark grayish-brown loam or clay loam, containing alkali. The material in this layer is lighter in both color and texture in the lower part, but no sand is reached.

An alkali determination at this point showed a concentration of more than 3 per cent alkali in the topmost 12 inches of soil, and the subsoil contained about three-fourths of 1 per cent.

River wash.—The Pecos River carries little gravel, but it does carry large quantities of medium and fine sand, which are constantly being deposited as low sand bars and islands only a few inches higher than the water of the river. These islands shift from place to place frequently, but where they remain stationary for a comparatively short time they are quickly covered by a dense growth of small salt cedars or by salt grass. The water table is high, alkali accumulates at the surface, and, except for the small quantity of forage they supply, river wash areas are of no agricultural value.

ALKALI

Parts of the irrigated land have become seepy, and alkali in harmful quantities has accumulated at the surface. This condition can not be improved until adequate drainage is provided. A drainage ditch, such as that in secs. 3 and 10, T. 2 N., R. 26 E., which removes surface water only, is not sufficient. An outlet which actually lowers the water table to a depth of 3 feet or more is necessary if this land is to be reclaimed so that crops can be grown with any degree of success.

On the accompanying soil map, areas in which alkali has accumulated in the surface soil in injurious quantities have been surrounded with red lines. In addition to these areas, there are others in which alkali is present and may accumulate at the surface whenever the water table rises sufficiently.

The results of alkali determinations in some of these areas are given in Table 3.

TABLE 3.—*Alkali determinations made in several places in the Fort Sumner area, New Mexico*

Area No.	Location	Quantity of alkali in—	
		12-inch surface soil	Subsoil
		Per cent	*Per cent*
1	Near northeast corner sec. 32, T. 3 N., R. 26 E., 2 miles south of Fort Sumner.	0.20	0.20
2	One-fourth mile north of center of sec. 3, T. 2 N., R. 26 E., 4 miles southeast of Fort Sumner	.23	.20
3	Center of northern side of sec. 10, T. 2 N., R. 26 E., 1 mile north of old Fort Sumner	.88	.31
4	One-fourth mile east of area No. 3	.85	.20
5	Southwest quarter of sec. 14, T. 2 N., R. 26 E., 1 mile southeast of old Fort Sumner	.70	.25
6	Northeast corner of sec. 22, T. 2 N., R. 26 E., 1 mile south of old Fort Sumner.	2.10	.64
7	One-fourth mile north of the center of sec. 26, T. 2 N., R. 26 E., 2¼ miles south of old Fort Sumner	3.00	.78

Accumulation of alkali at the surface even in small quantities may cause difficulty in obtaining a stand, and in large quantities it renders the growing of farm crops impossible. Soils of the Fort Sumner area, on account of the sandy or loamy character of the surface soil and the open sandy and gravelly subsoil, can be readily reclaimed if they lie sufficiently high above the water table maintained by the river and adequate drainage is provided. Attempts to drain and reclaim the low-lying heavily impregnated soils near the river channel are not believed to be practicable.

White alkali is predominant in this region. It is much less harmful than the sodium carbonates, or true alkalies. However, deficient drainage and heavy accumulation of white alkali have in places become serious, and unless drainage is provided will probably become more so.

Points at which alkali determinations were made have been indicated on the soil map by red dots, and the alkali concentration at that point is indicated in the form of a fraction. The upper number indicates the average concentration in the soil to a depth of 12 inches and the lower number the average for the subsoil to a depth of 5 feet or to the saturated subsoil, where this is reached at less depth.

It will be noted that at each point the alkali concentration is much greater in the upper foot than in the subsoil.

It has been found that plants in a clay soil or one of heavy texture will withstand a much higher concentration of alkali than in a sandy soil or one of light texture. In a very light sandy soil a concentration of 0.4 per cent or less prohibits the growth of most farm crops, whereas in a heavy soil sweetclover, alfalfa, and sugar beets are often grown where the concentration is 0.6 per cent, or even more.

Table 4 shows the results of pH determinations for several representative soils of the Fort Sumner area. These results were obtained by the quinhydrone method.

TABLE 4.—*pH determinations of soils in the Fort Sumner area, New Mexico*

Soil type	Depth	pH	Soil type	Depth	pH
	Inches			*Inches*	
Springer fine sandy loam	1½–10	7.55	Winslow fine sandy loam	1–10	8.45
Springer fine sand	0–10	7.95	Gila very fine sandy loam	1–12	8.05
Winslow clay	1½–10	8.30	Gila loam	1½–10	8.55
Winslow clay loam	1–10	8.30	Gila fine sand	0–12	8.05
Winslow loam	1–10	8.45			

SUMMARY

The Fort Sumner area includes a small irrigated section and the adjacent unirrigated upland region on the high plains of east-central New Mexico, in De Baca County.

Agriculture in this area is of two distinct classes, cattle and sheep raising, largely on the unirrigated lands, and general farming, fruit growing, and gardening on the irrigated lands.

Soils of the unirrigated upland region are characterized by their light fine sandy texture and by highly developed caliche which has a soil covering about 30 inches deep.

The lands which are now under irrigation, consisting of both old alluvial soils and those which have been deposited more recently, have in general a fine sandy or loamy surface soil, a heavier subsoil, and are underlain by gravel in the deeper part of the subsoil. The older and higher-lying areas of these soils have an accumulation of lime in spots in the subsoil, but no caliche.

On the irrigated lands the most important crops are alfalfa, fruit (consisting largely of apples but with an increasing acreage of grapes), corn, sweetpotatoes, and other row crops.

Dairying and poultry raising are becoming increasingly important industries.

Cultural and farm methods are good. Considerable commercial phosphate fertilizer is used. More conservative use of water and better provision for drainage are needed.

The Fort Sumner irrigated region includes a small somewhat isolated region but is well settled with fairly prosperous people who have all the conveniences and advantages of larger farming communities.

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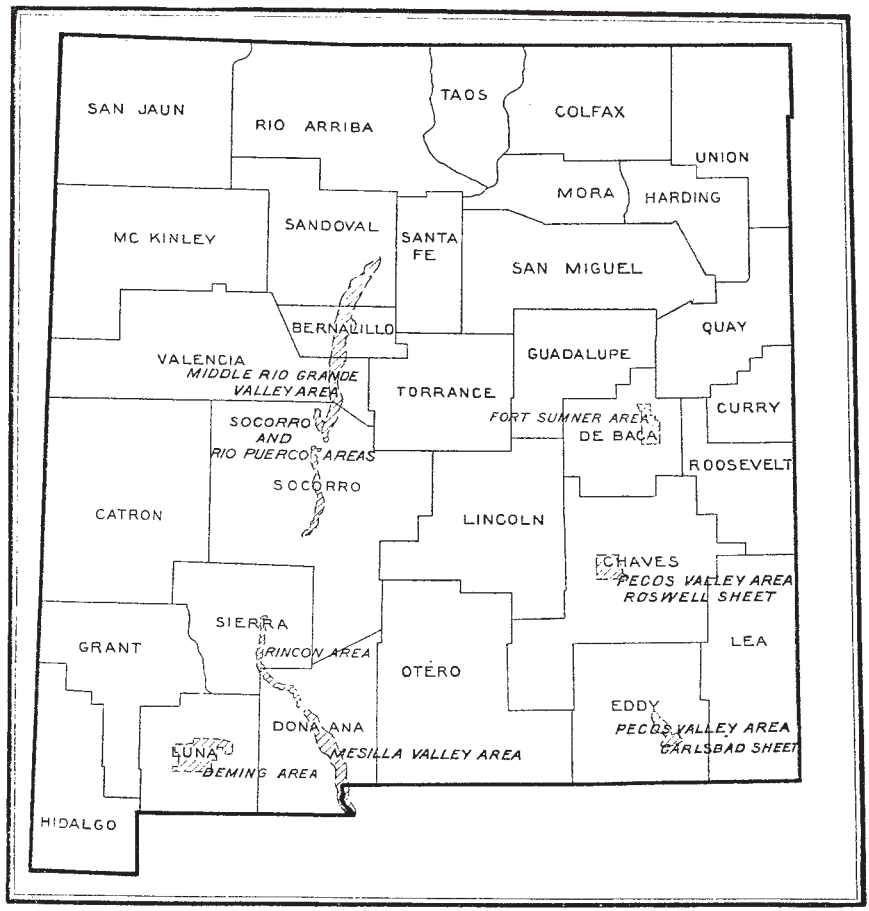

Areas surveyed in New Mexico, shown by shading

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