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CHAPTER 41

Ranges and Pastures of the Southern Great Plains and the Southwest

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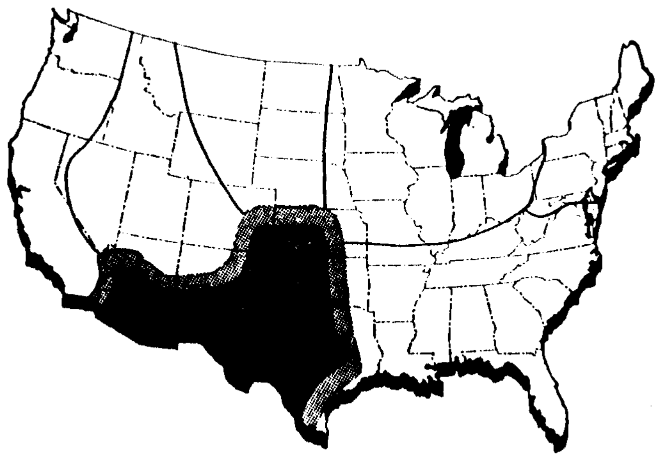

FIG. 41.1. The southern Great Plains and the Southwest.

THE southern Great Plains and the Southwest often are called "Big Country." (See Fig. 41.1.) This not only refers to the size of individual holdings but to the sparseness of urban centers. Annual precipitation averages less than 250 mm in the lower elevations of Arizona, New Mexico, and western Texas. It ranges up to 750 mm in the eastern portions of the southern Great Plains. Precipitation not only varies greatly within and among seasons and years but also among locations separated by only a few kilometers. (See Fig. 41.2.) About 70% of the average annual precipitation occurs during the spring-summer period in the Great Plains. In western New Mexico and southern Arizona the growing season precipitation occurs during summer, and spring normally is very dry. The entire region frequently is plagued by drought. During a prolonged drought, the Great Plains may take on a desertlike appearance. The region also may have high winds during some periods; coupled with a drought-induced reduction in vegetation and cover, this results in considerable wind erosion. Average annual evaporation ranges from 2160 mm at Oklahoma City to 3050 mm at Yuma, Ariz. (USDC 1968.) The frost-free period ranges from about 180 days in the northeastern part of the region to 340 days in the Yuma area.

Elevations in the southern Great Plains vary from 200 m in southern Texas to 1200 m in northeastern New Mexico. The sections of Arizona and western New Mexico considered in this chapter are desert or desertlike basins interrupted by mountains. The entire region is dissected with rivers and their accompanying floodplains. The soils are highly variable.

Because of the erratic weather conditions, dryland farming is high-risk in all but the eastern portions of the region. Because of the favorable temperatures, however, irrigated farming is highly productive where water of good quality is available. A high percentage of the land in the region is used for ranching, a much less intensified operation. Practices common on farmland may not be feasible on rangeland.

RANGELANDS

Land used for ranching varies from 50% of the area in the eastern part of the region to more than 95% of the area in Arizona, New Mexico, and the trans-Pecos of Texas. In the latter, farming generally is limited because of low precipitation. Much of the Edwards Plateau in Texas is used for ranching because of shallow and rocky soils and a rolling terrain. Productivity of the rangelands has been greatly reduced by overgrazing, droughts, and an increase in noxious plants. The Edwards Plateau ranches and adjacent areas are stocked with sheep, goats, and cattle. The remaining rangelands of the region

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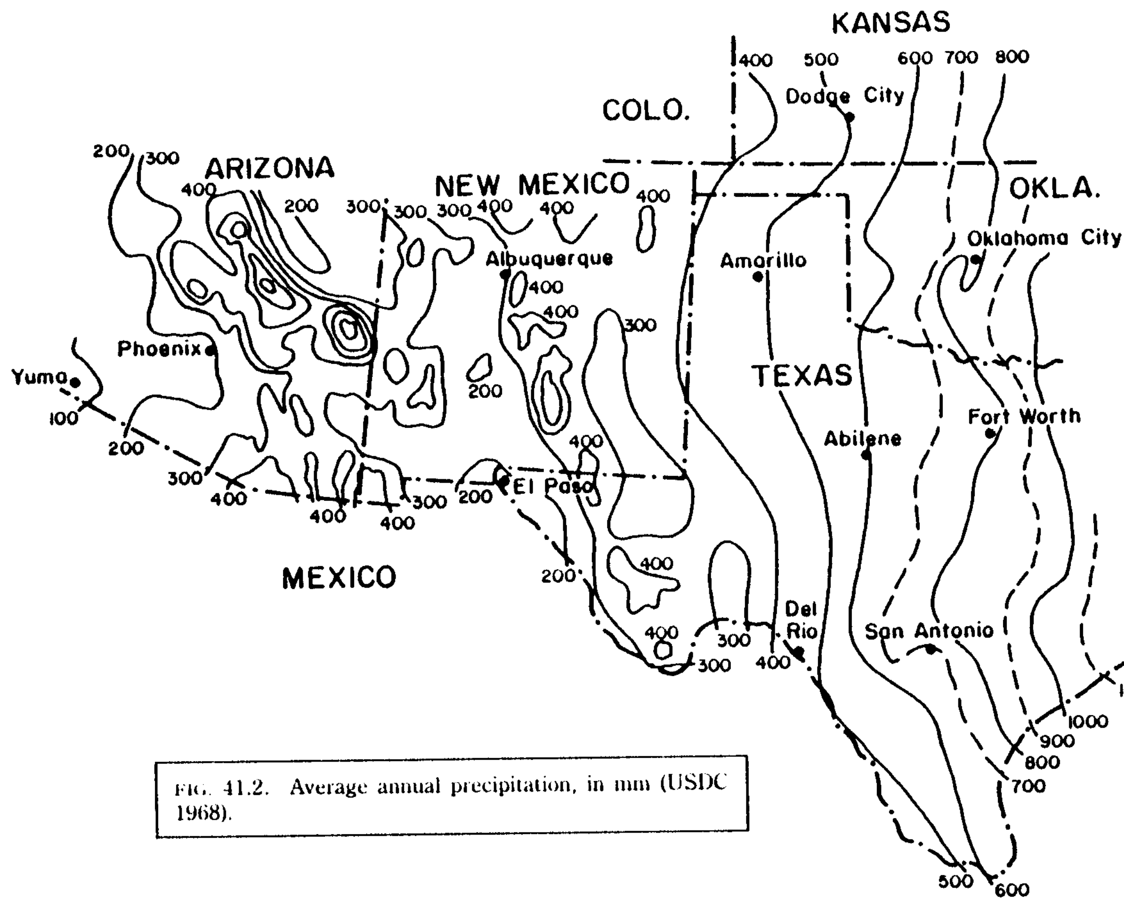

FIG. 41.2. Average annual precipitation, in mm (USDC 1968).

are stocked largely with cattle. (See Table 41.1.)

Much of the rangeland of the region has been invaded by noxious, woody plants. An increase of brush is responsible for the loss of grazing lands that formerly made a significant contribution to the production of domestic livestock. Stands of brush increase the cost of handling livestock, reduce livestock production, increase parasite damage, and require the use of more breeding males. Mesquite, *Prosopis juliflora* (Swartz) DC., competes with range forage for moisture on about 38 million ha in Arizona, New Mexico, Texas, and southwestern Oklahoma (Platt 1959). Shinnery oak, *Quercus havardii* Rydb., occurs on the deep, sandy soils of western Oklahoma, northern Texas, and eastern New Mexico. Sand sagebrush, *Artemisia filifolia* Torr., is a problem on the sandy soils of western Oklahoma and northern Texas. Juniper, *Juniperus* spp., dominates large areas in the Edwards Plateau and rolling plains of Texas (Gould 1975) and at elevations above the semidesert grasslands and below the ponderosa pine zone in Arizona and New Mexico. Small soapweed,

TABLE 41.1. Livestock numbers and selected crops in states of the southern Great Plains and the Southwest

	Arizona	New Mexico	Texas	Oklahoma	Kansas	Colorado
Livestock (000 head)[a]						
Cattle	1,000	1,500	13,700	5,800	6,000	3,025
Sheep	377	615	2,500	105	200	710
Goats[b]	. . .	. . .	1,450	. . .	. . .	. . .
Crops (000 ha)[c]						
Range	21,847	26,310	45,581	9,212	6,643	15,797
Pasture[d]	47	219	4,567	1,883	1,577	523
Hay	77	128	1,146	676	931	589
Silage	9	12	23	30	182	83
Fodder	1	10	127	47	123	38
Cereal grains	122	214	3,083	2,668	5,034	1,394

[a]USDA (1982a).
[b]Small numbers not estimated.
[c]Frey (1979); USDA (1982b).
[d]Cropland used only for pastures.

Yucca glauca Nutt., is a problem in eastern New Mexico and northern Texas. Tarbush, *Flourensia cernua* DC., occurs on 5.36 million ha in western Texas, southern New Mexico, and southwestern Arizona. Creosotebush, *Larrea tridentata* (DC.) Coville, is a serious problem in Arizona, New Mexico, and western Texas.

These are only some of the woody plants of concern to ranchers in the region. Snakeweed, *Gutierrezia sarothrae* (Pursh) Britt. & Rusby, and burroweed, *Haplopappus tenuisectus* (Greene) Blake, plus poisonous plants such as loco, *Astragalus* spp.; cocklebur, *Xanthium spinosum* L.; and milkweed, *Asclepias* spp., are also a problem. In many instances, as undesirable woody plants increase, there is a corresponding decline in the protective forage grasses and an increase in wind and water erosion. Part of the dust during windstorms and the sedimentation in streams and reservoirs comes from rangelands infested with brush. Certain brush species provide browse for wildlife, but heavy stands of those mentioned here depress wildlife populations, reduce the recreational value of the land, and, in some cases, constitute a serious fire hazard.

Damage of rangeland by rodents and rabbits often is underestimated. On deteriorated mesquite sand dune sites in southern New Mexico there was 81 kg/km² of rodent biomass (Wood 1969). This, plus rabbit populations that may range up to 250/km², exerts as much pressure on desirable vegetation as one animal unit/km². Rodents and rabbits consume vegetation, destroy roots and aboveground plant parts, and collect seed that would otherwise aid in natural revegetation. Even in good grassland areas the banner-tailed kangaroo rats, *Dipodomys spectabilis* Merriam, kept 10% of the area from vegetative production by denuding the ground in the vicinity of their mounds. Rangelands in good condition generally have fewer rodents and rabbits than do those in poor condition.

Vast range areas in the region sometimes are heavily infested with grasshoppers. Even a light infestation, with an average of six grasshoppers/m², consumes grass at about the same rate as a cow (Hewitt 1977). During periods of heavy infestation, when there may be 30–60/m², all the grass may be destroyed. Like rabbits and rodents, grasshoppers do damage beyond that caused by actual feeding. They cut plant parts and eat only part of them; they prevent natural revegetation; they eat the grass closer than livestock; and, when extremely abundant, they sometimes injure the crowns so that growth is reduced for several years. Other insects that sometimes cause damage are the New Mexico range caterpillar, *Hemileuca oliviae* Cockerell; armyworms, *Pseudaletia*, *Laphygma*, and *Prodenia* spp.; harvester ants, *Pogonomyrmex* spp.; and thrips, *Frankliniella* and *Thrips* spp. (Randolph and Garner 1961).

Control of Noxious Plants. Trends toward dominance by noxious plants can be halted or reduced by judicious use of mechanical and chemical control methods, revegetation of forage species, and control of the numbers of grazing animals and their seasons of use. Sound management principles are essential to the use of any control method on rangeland infested with brush. Once established, woody plants such as mesquite, juniper, oak, and sagebrush (*Artemisia* spp.) cannot be eliminated by good grazing practices alone. On rangelands dominated by brush, control measures are essential before benefits from other improvement practices, such as a grazing system, seeding, or water spreading, can be achieved.

The most effective control measure may vary for each particular site, specific vegetation, and degree of infestation. Brush control generally is less costly when invasion is just beginning and the brush plants are small and scattered. A control method should be employed that will not destroy the residual forage plants. On sandy soils heavily infested with brush, a broadcast chemical method may provide control of the undesirable plants and result in an increase in forage plants. On medium- to heavy-textured soils with a heavy infestation of brush and a poor stand of desirable plants, a mechanical method accompanied with seeding may be required. Broadcast mechanical methods generally are avoided on sandy soils because of the wind erosion hazard. Fortunately, natural revegetation often occurs rapidly on sandy soils following chemical control of the brush. Conversely, natural revegetation following brush contol often is very slow on medium- to heavy-textured soils.

CHEMICAL CONTROL. Often it is difficult to chemically control stands of mixed brush species with a single application, because herbicide requirements and time of peak readiness differ among various species. To be effective, foliage applications of herbicides must be applied at the proper stage of growth. In one study, treating mesquite even one week too early drastically reduced the effectiveness of 2,4,5-T treatments (Valentine and Norris 1960). Plants generally are most sensitive to foliage sprays of growth regulator herbicides when they are actively growing.

To achieve adequate initial control of many woody plants, two or more herbicidal applica-

FIG. 41.3. Aerial spraying of mesquite sand dunes in southern New Mexico. Controlling the mesquite increases forage production.

tions are necessary. Two aerial spray applications of 0.56 kg of 2,4,5-T/ha from one to three years apart killed 23–64% of the mesquite on sand dunes in southern New Mexico (Herbel and Gould 1970). Perennial grass yields on areas sprayed twice during the period 1958–61 averaged 234 kg/ha during 1963–68. On an adjacent unsprayed area the perennial grass production averaged 39 kg/ha. A leveling of the sand dunes and less wind erosion occurred on the sprayed areas. (See Fig. 41.3.)

Herbicides such as 2,4-D, 2,4,5-T, silvex, dicamba, and picloram control many species. Applied as broadcast sprays, they may be used on dense stands of weeds or brush. Individual plant treatments of dry herbicides are an effective and economical method of controlling sparse stands of brush. Monuron, tebuthiuron, picloram, and other herbicides are applied as powder, granules, or pellets around the bases of target plants (NRC 1968).

MECHANICAL METHODS. Bulldozing and mechanical grubbing, rootplowing, and cabling or chaining are the major mechanical methods of rangeland brush control.

Bulldozing is effective on sparse stands of many species. Bulldozer blades or front-end loaders may be fitted with a stinger blade, which is pushed under the crown of the plant to ensure uprooting of the bud zone.

A rootplow is a horizontal blade attached to a track-type tractor. Rootplowing cuts off the brush, generally at depths of 38 cm for mesquite or other resprouting species and at lesser depths for nonsprouting species. Rootplowing kills 90% or more of all of the vegetation growing on the area. The method is best adapted to dense brush areas where there is little or no residual grass and where seeding of desirable grasses is possible (Rechenthin et al. 1964).

Chaining and cabling involve the dragging of a 90- to 120-m anchor chain or heavy-duty cable in a loop behind two track-type tractors (Fisher et al. 1959). The method is effective in controlling nonsprouting species such as one-seeded juniper, *Juniperus monosperma* (Engelm.) Sarg., and Utah juniper, *J. osteoperma* (Torr.) Little. It also is useful in knocking down mesquite trees previously killed by aerial spraying, thereby reducing the cost of working livestock.

BURNING. Results of burning vary greatly and depend on both the susceptibility of a species to fire and the availability of fuel. Several range shrubs and weeds are ideally controlled by burning at the proper season if moisture conditions are good and precautions are observed. An example of fire use for range management is the burning of vegetation infested with shinnery oak. Summer burning is effective in controlling burroweed in southern Arizona (Tschirley and Martin 1961). Burning also is useful in removing old, stemmy forage growth from species such as sand bluestem and tobosa (Wright 1980; Wright and Bailey 1980).

GRAZING METHODS. Sheep and goats are utilized to control some plants. Animals select the more palatable plants or plant parts and are effective in controlling seedlings and young sprouts. However, continuous heavy utilization of the desirable forage species must be avoided.

Seeding. In this region the soil surface infrequently is moistened and the evaporation rate is high. Establishing seedlings often is difficult because of an adverse microenvironment (rapid drying, unfavorable temperatures, and crusting of the soil surface). The primary objective in seedling establishment is to place the seed in a favorable environment for germination. Establishment methods vary with site conditions.

Under rangeland conditions most grasses should be seeded 0.7-2 cm deep. In the southern Great Plains sufficient moisture for seedling emergence and establishment cannot be maintained on level, bare surface soil except with very favorable weather (Army and Hudspeth 1960). Establishment is a greater problem in the more arid areas of the Southwest. Use of mulches and land-forming procedures increases the chance of successful seedling establishment under difficult environments.

STUBBLE MULCHES. In forage establishment, plant residue improves soil moisture and protects the soil surface against wind and water erosion (Duley 1953). Stubble mulching is being used for seeding grasses in the Great Plains (Anderson 1959). It consists of planting a residue-producing crop (such as sorghum) a year before the grass is seeded. Sorghum is seeded in mid- to late summer to prevent seed formation before frost but in time to make 15-20 cm growth. Grasses are seeded the following spring. Sorghum improves the microenvironment for the grass seedlings.

RIPPING, PITTING, AND FURROWING. Pitting followed by cultipacker seeding has been the most consistent method of successfully seeding ranges in Arizona (Anderson et al. 1957). Ripping and contour furrowing also have been good methods of seedbed preparation on fine-textured bottomland soils. Broad, shallow pits generally last longer than conventional pits made with a pitter disk. The four-year average annual production of seeded buffelgrass was 776 kg/ha on an area with broad pits and 283 kg/ha on an area with conventional pits (Slayback and Cable 1970).

PLOWING AND SEEDING. Broadcast seeding native grasses at the time of rootplowing for control of mesquite failed to provide satisfactory stands at several locations in the High Plains of Texas (Jaynes et al. 1968). Loss of seedlings after emergence was attributed to rapid depletion of soil moisture from the loose seedbed after rootplowing and to severe weed competition. Broadcasting generally is a poor method of seeding.

Equipment has been developed for successfully seeding areas infested with brush in the arid Southwest (Abernathy and Herbel 1973). Brush and other competing vegetation are controlled with a rootplow. Seed are placed in a V-shaped press-wheel groove. Drag chains cover the seed with loose soil to a depth of about 1.3 cm. A conveyor picks up the brush behind the rootplow and deposits it behind the seeder, and a hydraulically operated bulldozer blade in front of the seeder forms basin pits. Thus, in a simultaneous operation the competing vegetation is killed, seed are placed in a firm seedbed, dead brush is used to partially shade the seeded area, and water is concentrated near the seed.

SPECIES TO SEED. Species for range seedings vary with climatic and site conditions and management of a specific range unit. A species may be adapted only to sandy soils in a fairly small area; other species may have wider adaptation. Considerable use is made of seed harvests of native species. It is important to choose native cultivars or ecotypes of local origin, generally within 300 km north and 450 km south of the area to be seeded. Many native and introduced species are used for seeding in the region.

Big bluestem, little bluestem, switchgrass, and indiangrass are important native species in the eastern part of the southern Great Plains; sand bluestem is adapted to sandy soils. Blue grama and sideoats grama are widely adapted throughout the region except for the most arid portions of the Southwest. Black grama, Lehmann lovegrass, and Boer lovegrass are some of the major species used in the more arid portions of the Southwest. Blue panicgrass, kleingrass, and buffelgrass commonly are used for seeding in Texas. Weeping lovegrass has been seeded in Oklahoma, northern Texas, and the foothills of Arizona.

Seeding rates generally are 100 pure live seed per meter of seeded row. Many grass plantings have been ruined by grazing before the seedlings were well established; newly seeded plants must not be grazed until they are well rooted. Severe infestations of rodents, rabbits, and insects are sometimes responsible for seeding failures.

Range Fertilization. In some parts of the region low amounts of N in the soil limit plant growth. Fertilizer N is economical only where there is adequate moisture and plant species that give N response. Nitrogen available for plant growth on grazed pastures after a few years of fertilization may amount to 50% of the annual requirement because of recycling through the grazing animal (Davidson 1964).

Grazing Management. Manipulation of the season of use and the intensity of grazing is an important way of increasing range productivity. A decline in grazing capacity has occurred due to overgrazing during droughty periods and a rapid increase in noxious shrubs (Herbel 1982).

On the Edwards Plateau near Barnhart, Tex., average annual livestock production for 1959–65 was 27% and 36% greater for four-pasture rotation and two-pasture rotation than for continuous yearlong use, all stocked at a moderate rate (Huss and Allen 1969). At Barnhart a combination of cattle and sheep was more profitable than was grazing either alone. At Sonora, combination grazing with cattle, sheep, and goats or with just cattle and goats was more profitable than was using sheep alone or cattle alone (Merrill 1969). Combination grazing is successful because of differential use of plant species and parts.

Short-duration grazing (SDG) or "cell" grazing may require an outlay of capital for fence and water developments. Short-duration grazing is a one-herd system with the units, commonly six to ten, laid out somewhat like a wagon wheel. In the center are corrals and watering devices. Movement of livestock to the next unit to be grazed is accomplished by opening the gate, which is located at the hub, and letting the livestock move themselves. Cell grazing requires short periods of livestock grazing, generally 2–14 days, when range plants are actively growing. Periods up to 28 days may be used when the plants are dormant. Frequent movement among units prevents livestock from overutilizing individual plants (Savory 1979).

In the southern rolling plains near Throckmorton, Tex., calf production per animal unit averaged 200, 208, and 221 kg/year for moderate continuous use, two-pasture rotation, and four-pasture rotation, respectively, for 1960–68 (Kothmann et al. 1970). Later, continuous grazing at 0.48 ha per animal unit month (AUM) was compared to SDG at 0.24 ha/AUM (Heitschmidt et al. 1982). Both total and average daily gains were similar, but because of the twofold difference in stocking rate, per-hectare production was approximately double in the SDG treatment.

In studies at Woodward, Okla., continuous yearlong grazing has been equal or superior to several rotation schemes (McIlvain and Shoop 1969).

Using weather and plant information and considering livestock needs, the "best pasture grazing system" has been developed in the Southwest (Herbel 1973). The system consists of defining an objective relative to the desired species composition for each pasture and then stocking accordingly. The system is opportunistic in that the use of forbs and short-lived grasses is maximized. They are of little value to the permanent range resource but contribute much to livestock nutrition (Nelson et al. 1970). No set stocking plan is used for a specified time period because great variations in weather affect plant growth. Livestock are moved when vegetation in another pasture can be grazed to the advantage of both plants and animals. In large pastures in the Southwest, periodic opening and closing of watering places is used to rotate grazing pressure to different areas within a pasture (Martin and Ward 1970).

The Ranch as a System. Ranches differ in the amount of water development, fencing, and equipment improvements; the proportion of various soil and vegetation types; wildlife values and recreational opportunities; kinds, breeds, and classes of livestock; supplemental feeding practices; and management objectives of the operator. These factors must be collectively considered to maximize production while maintaining the resource. When a variable is introduced, it affects the entire system. In northwestern Oklahoma, for example, clearing of brush, seeding, and fertilizing may be used to substantially alter the stocking pattern on a ranch (McIlvain and Shoop n.d.). In that instance only about 10–15% of a ranch should be used for seeded and fertilized weeping lovegrass. Its productivity and season of use dictate this, or a rancher must resort to more intensive management practices than most prefer.

Similarly, a southwestern rancher with a brush problem may want to initiate a program of deferred-rotation grazing. Later, when the brush in a pasture has been controlled, the grazing could be deferred one to three years to allow for a quicker recovery of desirable vegetation. After the brush on a major part of the ranch has been treated, it may be necessary to change to another grazing system to maximize profits.

IRRIGATED PASTURE AND HAY

Alfalfa, sorghums, and a number of grass species are the most important pasture and hay crops produced under irrigation in the southern Great Plains and Southwest. (See Fig. 41.4.)

Alfalfa. Alfalfa, one of the most important irrigated forage crops in this area, is adapted to a wide range of climatic and soil conditions; however, it requires a large amount of water for maximum production. Under irrigation, yields are in the range of 9–27 t/ha. On highly productive soils in southern New Mexico light and frequent irrigations using up to 190 cm of water resulted in higher yields and good water-use efficiency (Hanson 1967).

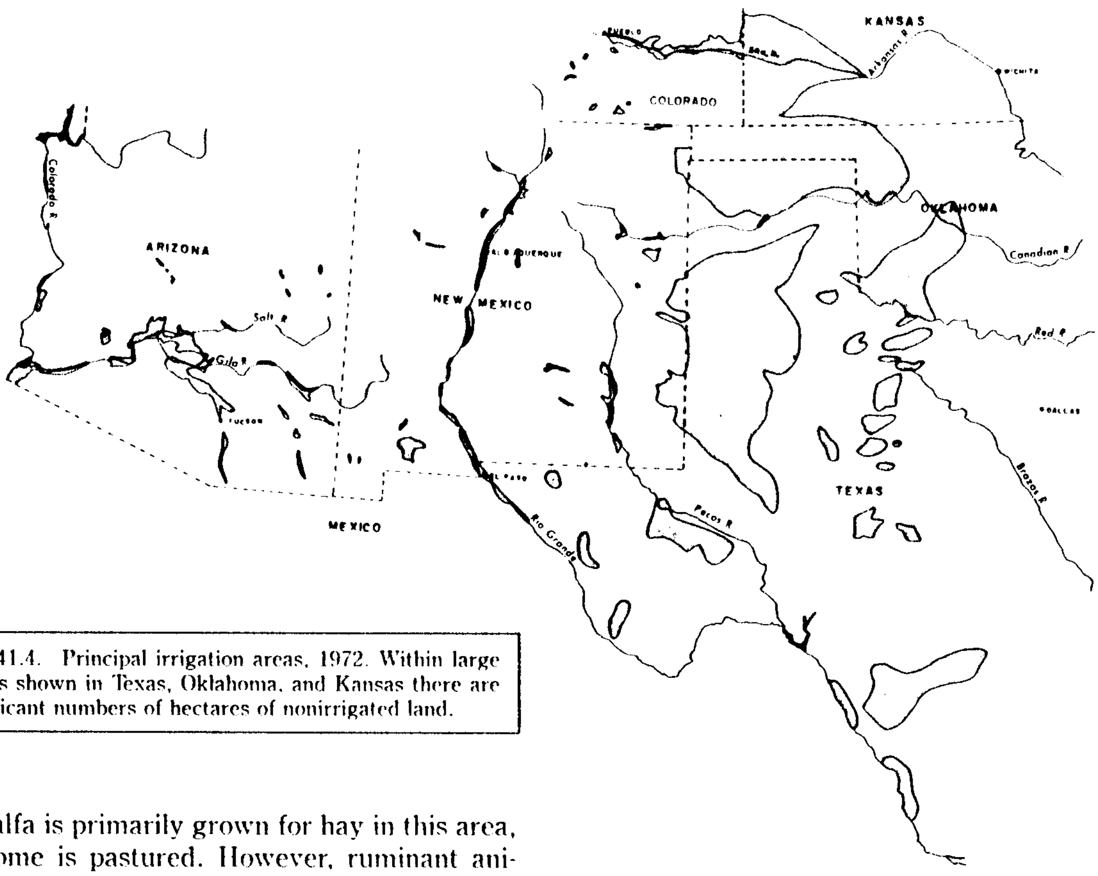

FIG. 41.4. Principal irrigation areas, 1972. Within large blocks shown in Texas, Oklahoma, and Kansas there are significant numbers of hectares of nonirrigated land.

Alfalfa is primarily grown for hay in this area, but some is pastured. However, ruminant animals grazing alfalfa may bloat, and caution must be exercised.

Irrigation water usually is applied using the border method; however, other methods such as sprinkling, flooding from contour field ditches, and flooding by basins are used. Care should be taken in designing and constructing the system since alfalfa stands are usually maintained for three or more years. Stands sometimes are reduced or lost by excess surface water caused by poor leveling or poor soil drainage.

Alfalfa is moderately tolerant to salts (Bernstein 1958; U.S. Salinity Laboratory Staff 1954); however, excessive concentrations of either soluble salts or exchangeable sodium, or both, reduce production. Leaching is the process of dissolving and transporting salts downward through the soil and is commonly used to help alleviate problems with soluble salts. Productivity of sodium-affected soils has been improved by a combination of leaching and treatment with gypsum and sulfur (Chang and Dregne 1955).

Alfalfa and perennial grasses are well adapted for the improvement of desert and semidesert soils for irrrigated agriculture. These forages improve permeability and aeration of soils if managed for high productivity. Alfalfa is especially valuable in crop rotation systems in the irrigated parts of the region.

When a thick stand is maintained, weed control is not as serious with alfalfa as with many other crops. Fall seeding has been popular in much of the region, partially because resulting weeds are fewer than those in spring seedings.

State experiment stations have developed cultivars to fit this region for specific insect, disease, and environmental conditions (Dennis et al. 1977; Melton et al. 1977). Examples are 'Mesa Sirca,' 'Sonora,' 'El Unico,' 'Sonora 70,' and 'Lew' for Arizona; 'N.M. 11-1,' 'Zia,' 'Mesilla,' and 'Rincon' for New Mexico and western Texas. Recently numerous private releases have become available that perform well in the region.

That alfalfa cultivars vary considerably in degree of fall dormancy is one of the most important factors determining area of adaptation. Dormant cultivars are generally adapted to the northern part of the region, semidormant cultivars to much of the region, and nondormant cultivars to only the southernmost part of the region.

Sorghums. Many different sorghum types and hybrids are used for silage, pasture, and hay under irrigation. Sudangrass and sudangrass hybrids are used commonly for summer pasture and less frequently for hay. Forage sorghum hybrids and hybrids between grain and forage types are used for silage. In parts of the region corn also is important.

Sorghum is a drought-tolerant crop, but it responds strikingly well to irrigation in the arid and semiarid portions of the region. Water requirement ranges from 41 to 61 cm/year (Quinby and Marion 1960). Sorghum is moderately tolerant of salts; however, special management may be needed in the drier portions of the region where salts are excessive. Sorghums do well on a variety of soils but yield best on soils with good tilth and drainage and relatively high fertility. A forage sorghum crop producing 70 t/ha of silage contains about 125 kg of N; therefore, large N amounts are removed from the soil and must be replaced. The depressing effects sorghum sometimes has on crops that immediately follow may be partially reduced by applying fertilizer N. Choosing forage sorghums resistant to lodging is important for use under irrigated, high-fertility conditions.

Other Irrigated Grasses. A large number of grass species are grown under irrigation in this region. They include cultivars of bermudagrass, tall fescue, tall and intermediate wheatgrass, ryegrass, blue panicgrass, hardinggrass, and kleingrass. Orchardgrass, smooth bromegrass, and reed canarygrass are grown to a limited extent in the northern part of the region. These grasses require about as much water for maximum production as does alfalfa. However, if less water is available, they can be maintained satisfactorily at a lower productivity. Under irrigation these grasses respond to high N levels if other fertilizer elements are adequate.

NONIRRIGATED FORAGES OTHER THAN RANGE GRASSES

In the drier parts of the region, particularly in the lower elevations of the Southwest, tame pastures generally cannot be established or maintained without irrigation. In the eastern part, small-grain pasture, both dryland and irrigated, is one of the most important forages. In west Texas as much as 1 million ha of wheat and 0.5 million ha of other cereals may be planted for winter pasture (Holt et al. 1976). If there is sufficient moisture, wheat, oats, barley, and rye often are grazed. It is common practice to harvest grain from these crops, and careful grazing management must be practiced if optimum grain yields are to be realized.

Perennial grasses such as bermudagrass, johnsongrass, buffelgrass, and several wheatgrasses and legumes supply considerable forage without irrigation. Generally, their productivity is limited by moisture; however, soil type, fertility, and soil physical condition also may be limiting.

QUESTIONS

1. How is annual precipitation related to the occurrence of warm- and cool-season forage species on rangeland?
2. What are some of the major brush problems of the region? How does this affect ranch operations? What are the two major methods of controlling noxious brush species? What are three factors governing the selection of control methods?
3. What are the problems associated with seeding rangelands? What seeding procedures are used to help alleviate these problems?
4. What classes of livestock have been found to be most profitable in the Edwards Plateau? Why is it important to have flexibility in stocking ranges of the Southwest?
5. What are the major problems associated with irrigated forage production in the region?
6. Contrast the management of sorghums for forage under the conditions of irrigation and nonirrigation.
7. List and discuss the most important tame forage species of the region.

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