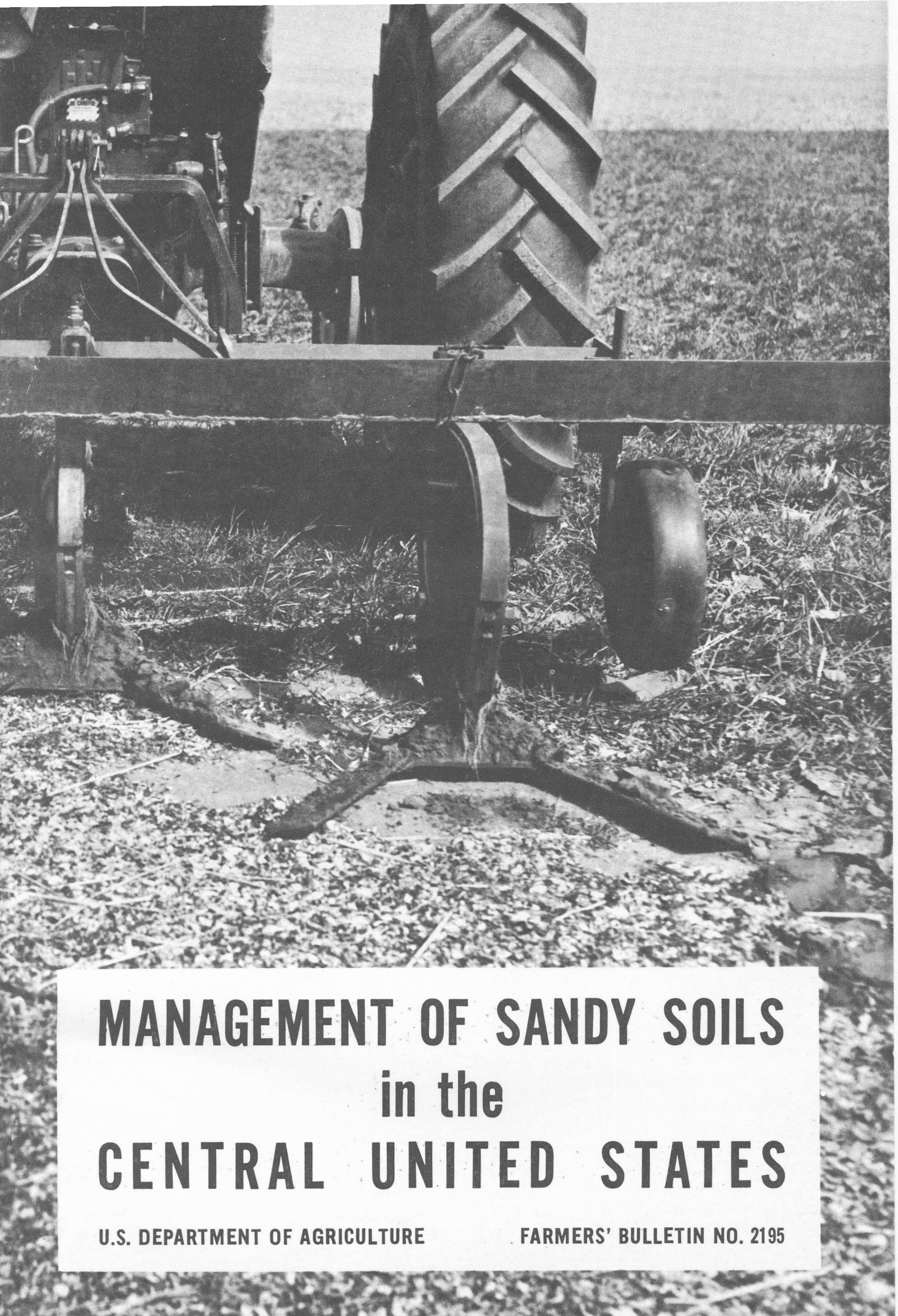

MANAGEMENT OF SANDY SOILS in the CENTRAL UNITED STATES

U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN NO. 2195

CONTENTS

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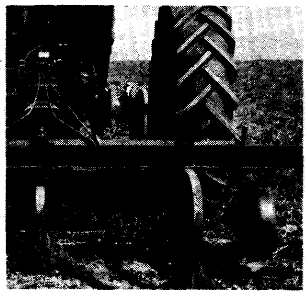

By W. S. Chepil and Earl Burnett, research soil scientists, and F. L. Duley, soil conservationist (retired), Soil and Water Conservation Research Division, Agricultural Research Service [1]

Sandy soils occur throughout a 12-State region in the central part of the United States.

One continuous sandy area, lying mostly in Nebraska and extending into South Dakota and Wyoming, covers about 20 million acres. Another covers about 18 million acres in Texas and New Mexico.

Other States in the region are Montana, North Dakota, Minnesota, Iowa, Colorado, Kansas, and Oklahoma. As shown in the table on page 4, sandy soils in the region total about 100 million acres.

Soils designated in this bulletin as sandy are sands, loamy sands, and sandy loams. These designations refer to the texture of the surface soil—soil within the maximum depth of tillage or within the topmost soil horizon in untilled soil.

There are many kinds of sandy soils in the central States and each one has some features different from the others. Published soil survey maps and reports showing kinds of soil and giving interpretations as to their best management are available for many counties from the Soil Conservation Service or the State experiment station. See your local soil conservation district for assistance in planning and carrying out a program of good land use on your farm or ranch.

Both shallow and deep sandy soils are considered in this bulletin, but wet sandy soils are not.

Earth material from any depth within the root zone of plants is considered in this bulletin as soil.

Sands and loamy sands are known as coarse-textured and sandy loams as moderately coarse-textured soils.

Sandy soils contain in the surface soil from 43 to nearly 100 percent of sand grains, which are composed of quartz or other minerals usually resistant to breakdown by the weathering forces.

Because of these characteristics of

[1] Numerous persons in the Soil Conservation Service, the Forest Service, the Extension Service, and State agricultural experiment stations in the central United States supplied information for use in this bulletin.

sandy soils, and because these characteristics make them generally highly susceptible to wind erosion, profitable cultivation of sandy soils in the central part of the country requires adherence to a number of management practices, chief among which are suitable cropping systems, stubble mulching, stripcropping, and fertilizing.

Sandy soils not suited to cultivation need careful attention to methods of revegetation and controlled grazing.

Approximate acreage of sandy soils in subhumid and semiarid regions of central United States, by State and by land use, 1959

State	Total sandy soils	Land use				Percent of sandy soil in cultivation
		Cultivated			Grass and woodland	
		Classes II to IV [1]	Classes V to VII [1]	Total		
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	
Colorado	7, 422, 000	1, 855, 000	29, 000	1, 884, 000	5, 538, 000	25
Iowa	631, 000	455, 000	37, 000	492, 000	139, 000	78
Kansas	6, 367, 000	3, 237, 000	399, 000	3, 636, 000	2, 731, 000	57
Minnesota	3, 766, 000	2, 470, 000	90, 000	2, 560, 000	1, 206, 000	68
Montana	5, 400, 000	2, 449, 000	251, 000	2, 700, 000	2, 700, 000	50
Nebraska	22, 000, 000	4, 068, 000	432, 000	4, 500, 000	17, 500, 000	20
New Mexico	8, 030, 000	480, 000	50, 000	530, 000	7, 500. 000	7
North Dakota	3, 377, 000	2, 129, 000	50, 000	2, 179, 000	1, 198, 000	65
Oklahoma	4, 618, 000	990, 000	86, 000	1, 076, 000	3, 542, 000	23
South Dakota	2, 871, 000	600, 000	179, 000	779, 000	2, 092, 000	27
Texas	32, 656, 000	8, 960, 000	809, 000	9, 769, 000	22, 887, 000	30
Wyoming	3, 063, 000	195, 000	74, 000	269, 000	2, 794, 000	9
Total	100, 201, 000	27, 888, 000	2, 486, 000	30, 374, 000	69, 827, 000	------

[1] The classes referred to are land-capability classes. For an explanation of these, see p. 6.

SIX CLIMATIC AREAS

Two climatic factors greatly influence soil-management practices in the central States:

- Effective precipitation (precipitation and evaporatation combined).
- Temperature (average temperature and length of frost-free period combined).

Differences in these and other factors make it necessary to manage sandy soil in different ways. For purposes of discussion, therefore, it is desirable to divide the central States into six climatic areas.

On the basis of effective precipitation, which decreases from east to west, two climatic regions are designated—the subhumid and the semiarid (fig. 1). This bulletin is not concerned with sandy soils outside these two regions.

Further division is made on the basis of temperature. As figure 1 shows, the subhumid and semiarid regions are each divided into three parts—northern, central, and southern.

In the extreme northern parts of

the 12-State region, the average annual temperature (a point midway or nearly midway between the highest and lowest temperatures of a year) is about 35° F., and the frost-free period (growing season) is about 100 days. In the extreme southern parts, the average annual temperature is about 75°, and the frost-free period is about 300 days.

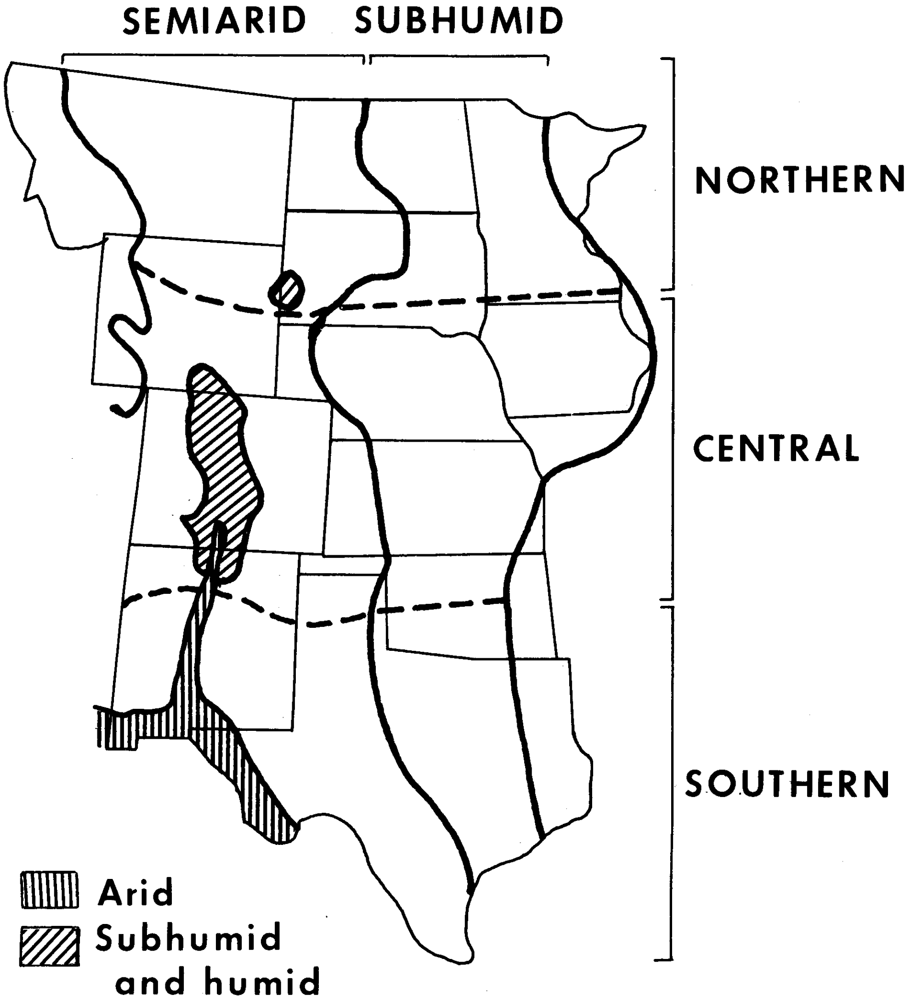

Figure 1.—**Climatic areas in the central United States—subhumid and semiarid (east to west), and northern, central, and southern. Sandy-soil areas within these climatic areas are shown in figures 2 through 7.**

USES OF SANDY SOILS

Most of the sandy soils in the central States are in capability classes defined by the Soil Conservation Service, U.S. Department of Agriculture, as classes III to VII. A very small acreage is in class II.

In the SCS classification system—

- Class II can be cultivated with moderate conservation measures.
- Class III can be cultivated but with much greater care and more intensive practices.
- Class IV is suited for only occasional or limited cultivation with intensive practices.
- Class V is not suited for cultivation but is suited for permanent vegetation, such as grass or woodland, without special restrictions on use.
- Class VI is suited for permanent vegetation with moderate restrictions on use.
- Class VII is suited for permanent vegetation with severe restrictions on use.

The wind erosion hazard is the primary reason why most of the sandy soils are in classes with greater use restrictions than class II.

About 30 million acres of the sandy soils in the central States are in cultivation (see table, p. 4). Most of the uncultivated sandy soils are in native or introduced grasses, or are woodlands.

Texture of the surface soil is one of the important factors that determine proper use of sandy soils. *Sands*, deep or shallow, are generally suited only for permanent vegetation (mostly land class VII in the drier and warmer areas and land class VI in the cooler and more humid areas). *Loamy sands* in the drier and warmer areas are suited principally for grasslands (mostly land classes VI and VII), but in the more humid and cooler areas the better grades (land class IV) may be used at least temporarily for cultivated crops. *Sandy loams* can be used for cultivated crops to a greater degree than the coarser-textured soils. They fall mostly in land classes III and IV in drier and warmer areas and in II and III in the more humid and cooler areas. They grade in performance and characteristics into medium-textured soils with which this bulletin is not concerned.

Other factors important in determining land use are depth to the subsurface soil, texture and structure of the subsurface soil, amount and state of decomposition of organic matter, seasonal and annual temperature, wind velocity, and topography. All these factors influence available moisture and nutrients, root penetration, and general development of crops.

The influence of all these factors on land use will be indicated in this bulletin.

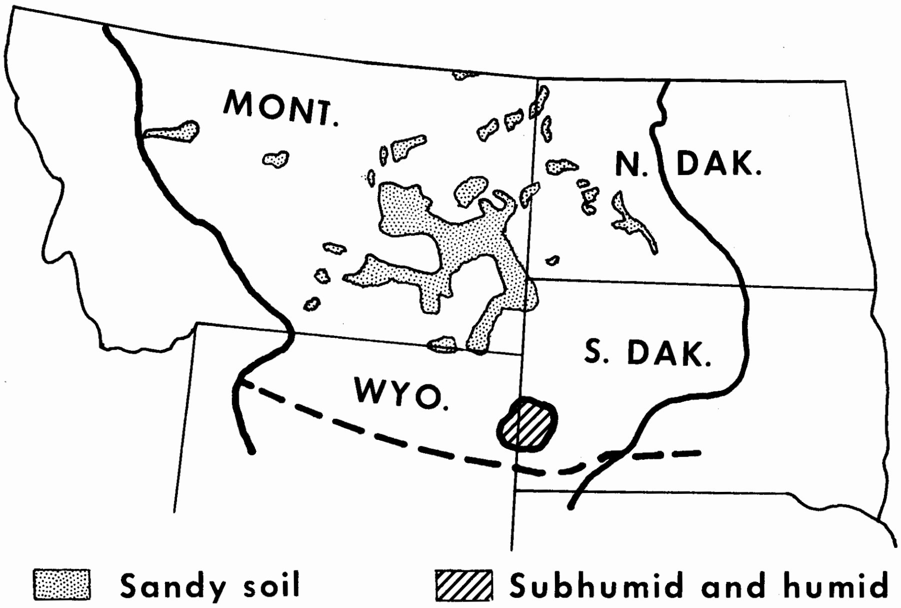

Figure 2.—**Northern semiarid area.**

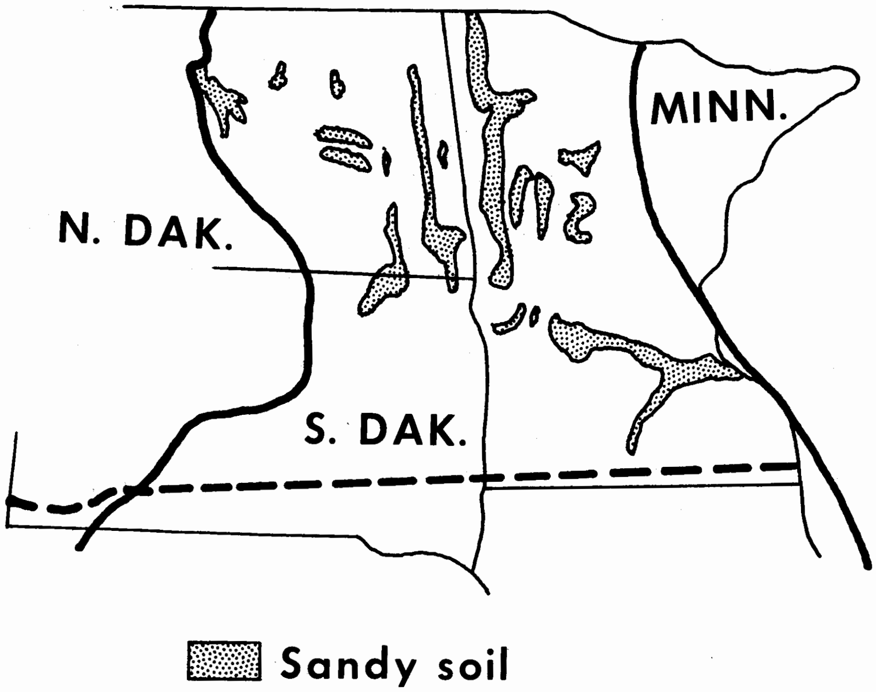

Figure 3.—**Northern subhumid area.**

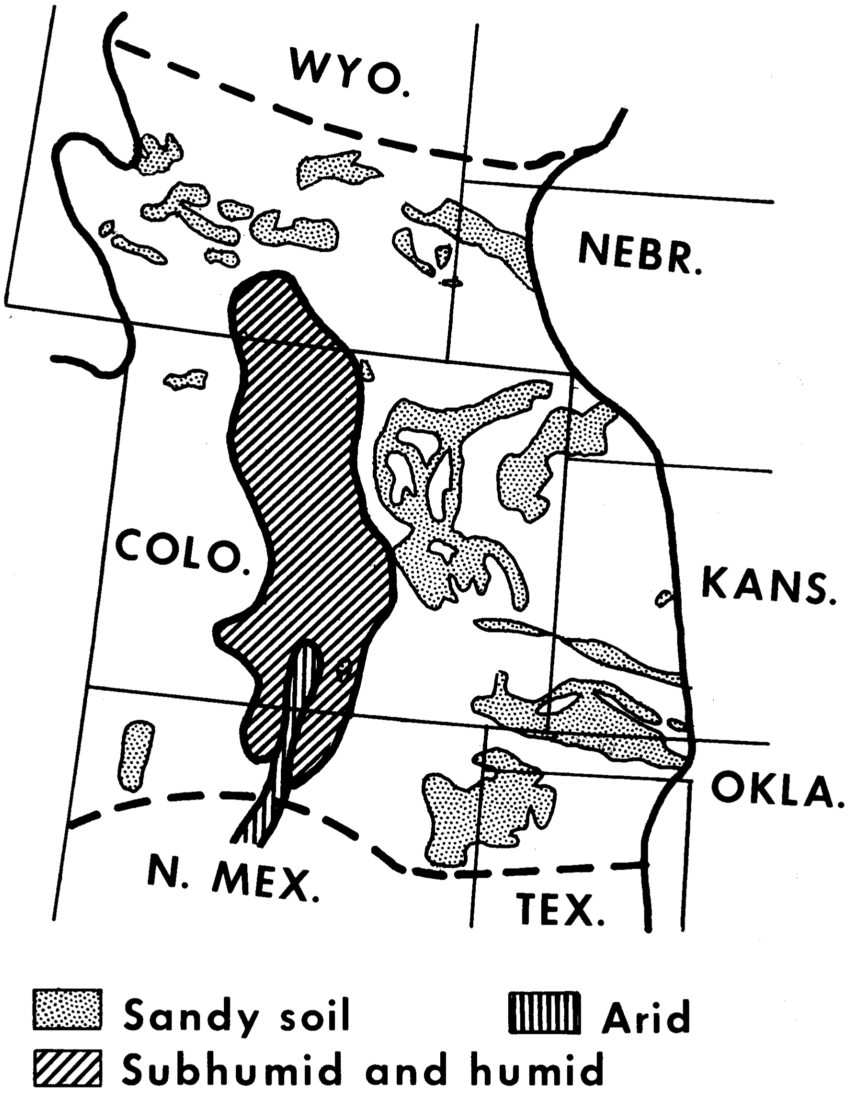

Figure 4.—Central semiarid area.

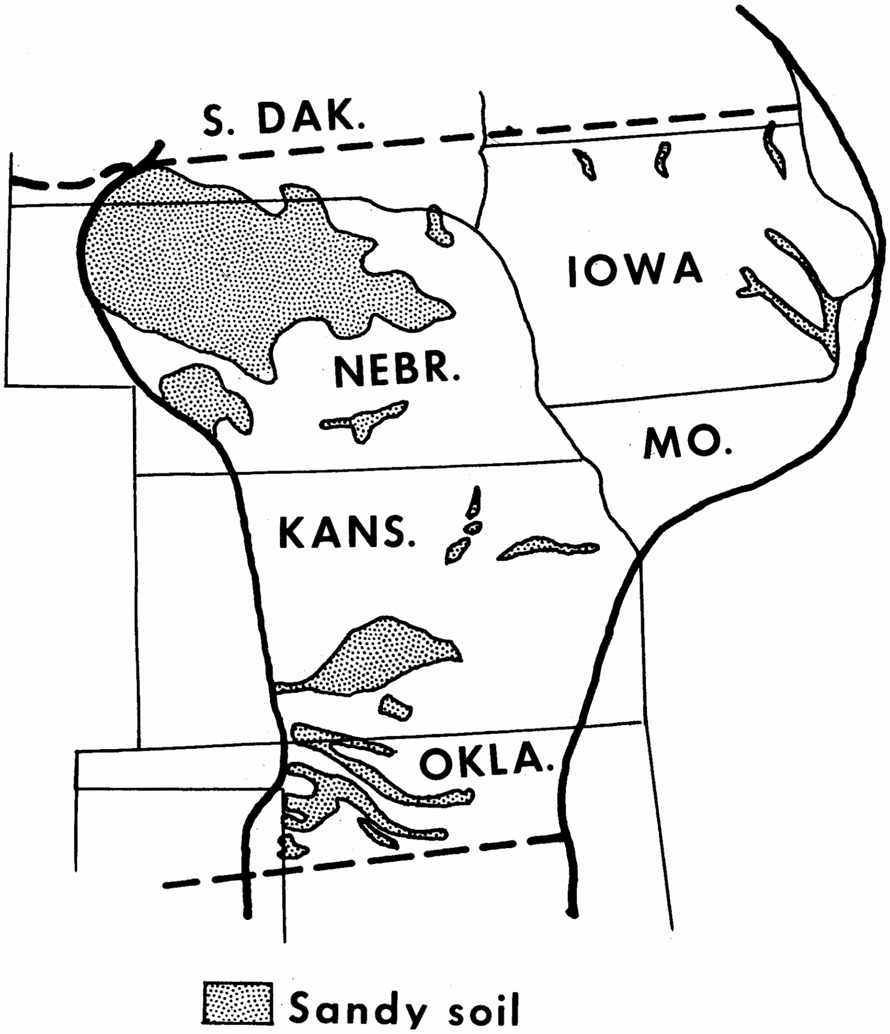

Figure 5.—Central subhumid area.

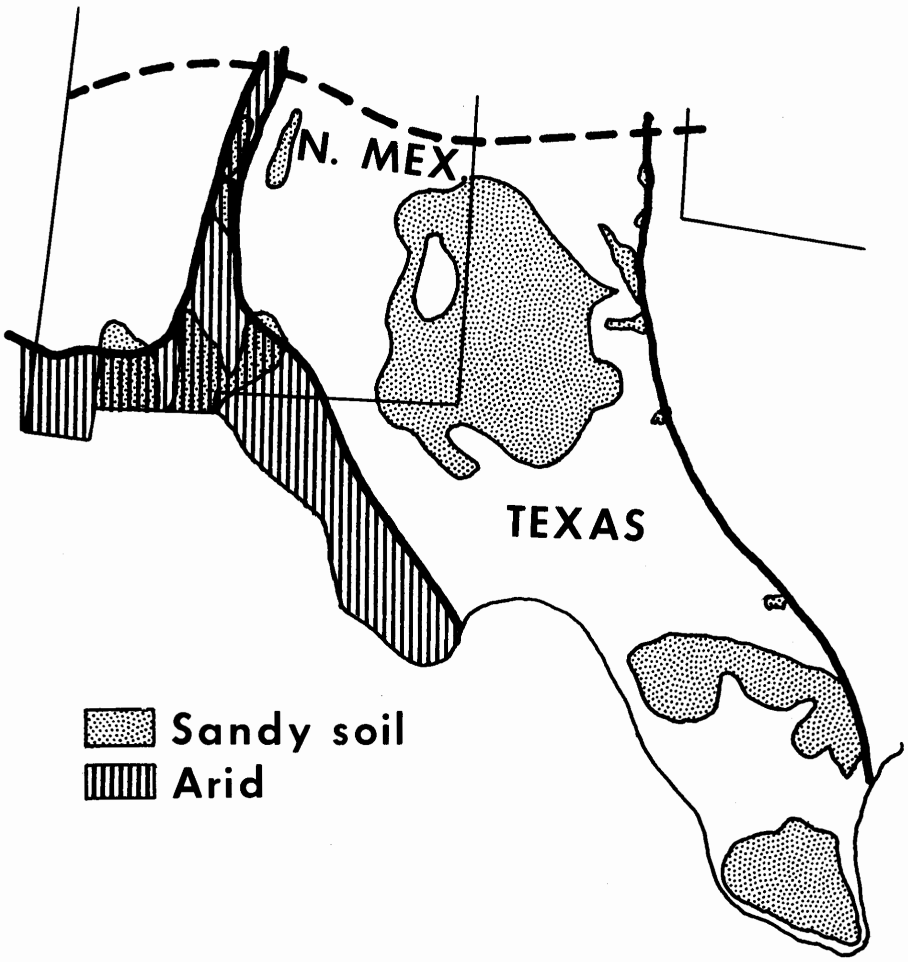

Figure 6.—**Southern semiarid area.**

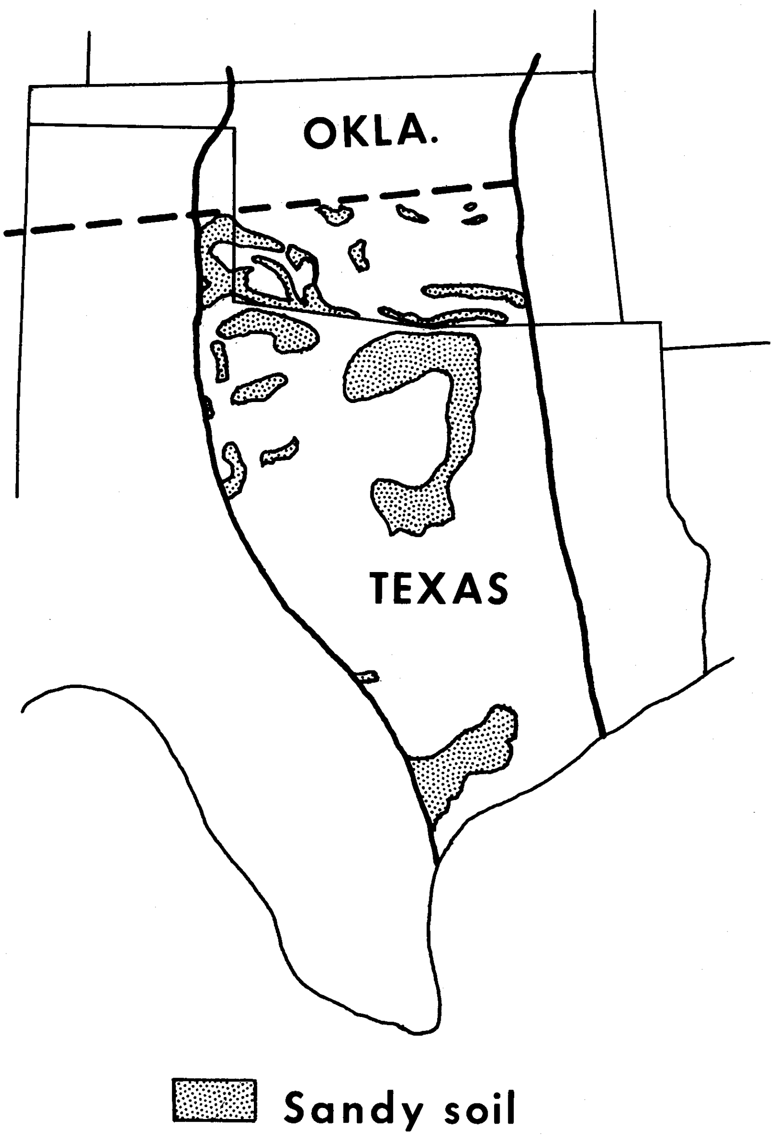

Figure 7.—Southern subhumid area.

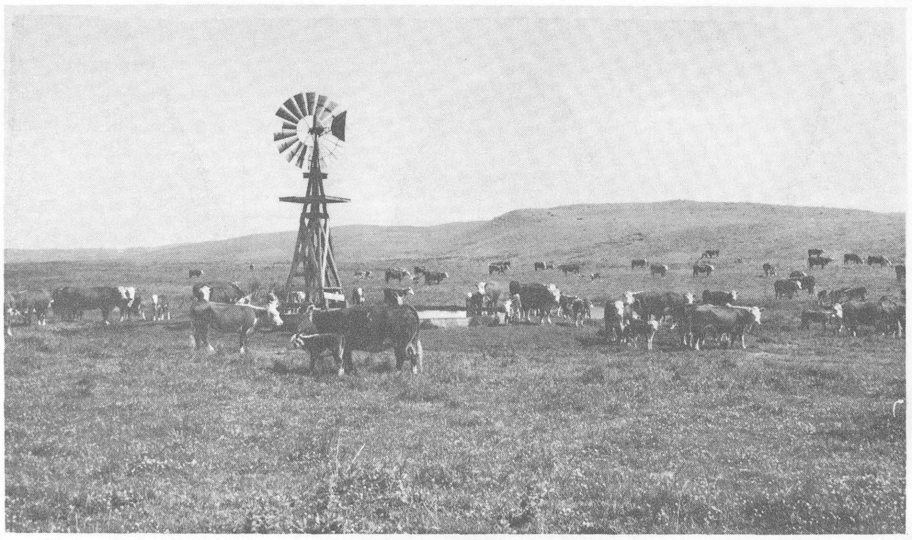

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Figure 8.—**Typical view in the sandhill area in Nebraska. This area of about 13 million acres is largely covered with grass and is used for cattle grazing.**

The main agricultural uses of sandy soils in each climatic area of the central States are:

NORTHERN SEMIARID AREA

Short season spring grain crops and fall rye; some early maturing corn in rotation with spring grain crops on better grade sandy loams; livestock on coarser-textured soils of the sandy rangelands.

NORTHERN SUBHUMID AREA

Spring grain crops, fall rye, flax, soybeans, and some corn generally rotated with forage crops such as sweetclover, grasses, and alfalfa for soil improvement and for raising of livestock on loamy sands and sandy loams; range livestock on vegetated sands.

CENTRAL SEMIARID AREA

Winter wheat principally in the northern part and grain sorghum in the southern part on sandy loams; mostly range livestock on vegetated loamy sands and sands.

CENTRAL SUBHUMID AREA

Winter wheat; corn (in the northeast); grain sorghum (in the southwest); grazing on coarser-textured soils.

The sandhill area (mostly sands) in the heart of the sandy-soil area of Nebraska is suited only for permanent grass and for livestock production (fig. 8).

The somewhat finer-textured sandy soils (mostly loamy sands and sandy loams) around the sandhill area of Nebraska are suited both for tame and native pasture and for cultivated crops. Loamy sands and sandy loams of the Great Bend area in Kansas are used principally for cultivated crops and the sands and loamy sands mostly for pasture.

SOUTHERN SEMIARID AREA

Cotton, grain sorghum, and forage sorghum are the only adapted cultivated crops of importance, except in the pump-irrigated sections where small grain, alfalfa, and improved pasture are used; livestock is common on coarse-textured sandy rangelands.

SOUTHERN SUBHUMID AREA

Livestock; a variety of cultivated crops, including cotton, grain and forage sorghum, peanuts, wheat, corn, oats, barley, and legumes; native and cultivated grasses.

Grasses generally are well suited to sandy lands in these areas. Most grasses have a fibrous root system, and this makes it possible for them to benefit from small rains. Many grasses go into a semidormant condition after they have used up the water; they recover and grow as soon as the next rain comes.

SANDY-SOIL PROBLEMS

With any kind of soil, the objective of good soil management is to maintain a high degree of fertility and to obtain maximum production of crops.

Compared with finer-textured soils, sandy soils have certain advantages as well as disadvantages. In addition, they have features that are advantages under some conditions and disadvantages under others. In the central States, the bad features of sandy soils generally outweigh the good, and sandy-soil management is largely a matter of overcoming their effects.

Features That May Be Good or Bad

Sandy soils give up water to the crop more readily than finer-textured soils. Whether this is good or bad depends on the kind of crop, whether the crop is grown for grain or for forage, and whether the land is irrigated. If there is no water table and no fine-textured soil within the root zone, a crop grown on sandy soil will use up water faster than one grown on finer-textured soil; hence it is more likely to wither and die before the next rain. If the crop is grown for forage, it could be harvested before it dries up; but if for grain, no grain may be harvested. If water and plant nutrients are sufficient, high yields can be produced on sandy soils.

Sandy soils have a relatively high infiltration rate. Therefore a given amount of rain penetrates deeper in such soils than in finer-textured soils, and less water is lost by evaporation. In areas of low rainfall, this causes high infiltration rate to be a good feature of sandy soils: Showers often benefit crops on sandy soils but do little good on finer-textured soils.

The high infiltration rate is also a good feature after heavy rainfall, provided there is enough finer-textured soil at the lower part of the root zone to hold water and dissolved nutrients for use by the crop; but if the soil is sandy to considerable depth, some water may penetrate below the root zone and become unavailable for plant growth.

The possibility of too-deep penetration of water reduces the value of summer fallowing on sandy soils: Some of the water stored by the fallow may penetrate below the root zone and become unavailable to the crop.

Crop residues decay rapidly on sandy soils. This is good because decayed vegetative matter gives much-needed nitrogen to crops. It is bad because vegetative cover sufficient to prevent soil erosion is difficult to maintain.

Bad Features

Following is a summary of the bad features of sandy soils:

- Wind erosion is a hazard wherever sandy soils occur in the central States.

Susceptibility of these soils to wind erosion is due to their lack of stickiness—sand grains do not stick together. Few soil aggregates, or clods, can be built, and whatever aggregates are built are readily broken down by weather and tillage.

Wind erosion is more severe in the semiarid region than in the subhumid region. Sands and loamy sands are more susceptible to it than sandy loams. Fine and very fine sands, loamy sands, and sandy loams are more susceptible than medium and coarse. Texture of the subsurface soil has no immediate bearing on wind erodibility.

Wind damages sandy soils by steadily removing silt, clay, and finely divided organic matter, leaving sand behind. Soils subject to this sorting action over a period of years become more and more sandy at the surface.

Some sandy soils that were once productive have become covered with shifting sand dunes. Most of these badly deteriorated soils have lost—down to the depth of cultivation—from 10 to 75 percent of the silt, clay, and organic matter that they contained when they were broken from virgin sod.

Summer fallowing adds to the wind erosion hazard and is therefore impractical for most sandy soils, especially in drier areas.

Some of the wind erosion problem appears to arise from cultivation of land classes V, VI, and VII, which are suited primarily for grass.

Throughout the agricultural history of the central States, millions of acres of these land classes have been broken out of sod, farmed for a few years, and then abandoned. Some of the abandoned lands have been reseeded to grass and some have been left to revert slowly to grass. Most of them are less productive than they were before they were broken from virgin sod.

In 1959 about 2.5 million acres of sandy lands in classes V, VI, and VII were in cultivation in the central United States (see table, p. 4). They should be seeded permanently to grass.

- Water erosion may damage sandy soils on sloping land, especially in the subhumid region. The sandy loams are more susceptible to water erosion than the coarser sandy soils because of slower infiltration rate.

- Lack of soil moisture is the major factor limiting crop production in the semiarid region.

- Some sandy loams contain enough silt and clay to bind the sand particles together. In wet weather the soil disperses and becomes compacted of its own weight and with machinery. In dry weather the compacted soil may dry and become very hard. Such soil is difficult to penetrate with tillage implements, and the cemented sand particles, being abrasive, cause implements to wear rapidly. Moisture and plant roots also have difficulty in penetrating this compact soil.

• Most sandy soils are lower in nitrogen than finer-textured soils. Some are also low in phosphorus, potash, and other plant nutrients. Those that have a limy subsoil and are in blowout areas are especially low in phosphorus.

• Many sandy soils of the subhumid region are deficient in lime. In the semiarid region, sandy soils that have been under irrigation for some time may be deficient in lime.

Major special problems of sandy soils in individual areas:

NORTHERN SEMIARID AND SUBHUMID AREAS

These areas lack suitable fall-seeded crops to protect land from wind erosion during the late winter and early spring. Stubble mulching is often ineffective in the semiarid area because of crop failures and lack of sufficient stubble. Stubble mulching is difficult to use in the subhumid area because of difficulty of killing weeds under lower temperature and more humid conditions.

CENTRAL SEMIARID AREA

The difficulty of properly managing cultivated land in this area is largely due to the fact that grain sorghum is the only major crop that can be grown in the southern part and winter wheat is the only one in the northern part. When a crop fails to produce adequate cover (and it often does in this area), large expanses of land become subject to wind erosion. Large areas of sandy soils suitable only for grassland are under cultivation here.

SOUTHERN SEMIARID AREA

Cultivation of sandy soils in the Great Plains section of the southern semiarid area presents exceptionally difficult management problems. The difficulties are due to—

1. Large expanses of very erodible cultivated sandy soil that should be in permanent grass, together with extremes of high temperature, high wind velocity, and low effective precipitation.

2. High temperatures, which cause rapid decay of crop residue that could be used for wind erosion control.

3. Small number of adapted crops.

SOUTHERN SUBHUMID AREA

In general, slopes are steeper in the southern subhumid area than in the southern semiarid area, and water erosion is a more serious problem.

Wind erosion is less serious than in the other southern area. There is less sandy land, and much of it is still in native range. Streams and their growths of brush limit the size of fields, and this reduces the wind erosion hazard.

Good Features

Following is a summary of the good features of sandy soils:

• With the exception of some sandy loams, they generally have an open structure and are well aerated.

• Because of their generally open structure, low water-holding capacity, and lack of stickiness, sandy soils can be tilled more easily than most other soils.

• Since sandy soils dry rapidly, they warm early in the spring. This makes early seeding of spring grain crops possible. The earlier the seeding, the greater the likelihood that the crop can overcome the effects of hot, dry winds in summer.

Nonirrigated Conservation Cropping Systems

A conservation cropping system that will improve and permanently sustain a high soil productivity should be planned. On sandy soils in the central States, the high sustained production and improvement of nonirrigated cultivated land may be accomplished principally by suitable crops and crop rotations, stubble mulching, stripcropping, fertilizing, terracing, and contour tillage, wherever they are suited.

Since the subhumid region has a better moisture supply than the semiarid region, land use can be more intensive there. But more intensive land use must be accompanied by intensive soil improvement measures. Rotation of small grains with intertilled crops, grasses, and legumes is imperative in the subhumid region, and all the crops in the rotation should be supplemented with fertilizers.

In planning a conservation cropping system for sandy soil, allow for change; make the plan flexible. It is almost certain that change will be necessary in any plan you may devise.

Unfavorable weather is likely to cause some crop failures, or near failures. Your plan should provide for a substitute or cover crop. Avoid getting caught with little or no plant or plant-residue cover.

You should also be ready with a plan that will meet possible changes in market conditions, in feed supplies, or in conservation emergency needs arising from drought or wind erosion.

Practice stubble mulching wherever it is suitable. Stubble mulching is a system of farming in which tillage, seeding, and harvesting are performed with the aim of keeping a crop-residue cover on the surface of the soil.

The purposes of maintaining a crop residue cover are to—

- Protect the soil from erosion by wind and water.
- Reduce sealing of surface soil resulting from raindrops striking bare ground.
- Improve water intake rates.

Stubble-mulch farming is valuable, and especially so on sandy lands, throughout the central United States.

Stubble-mulch tillage should be such as to leave stubble standing (erect) as much as possible. Standing stubble is about twice as effective in controlling wind erosion as flat stubble. Standing stubble also helps to increase soil moisture by trapping more snow.

In areas where stubble mulching is insufficient to control erosion, stripcropping is an excellent supplementary practice. In such areas, it should be combined with stubble mulching.

Stripcropping is a system in which narrow strips of an erosion-susceptible crop or fallow are placed between strips of an erosion-resistant crop. The purpose is to reduce the distance, along the direction of prevailing wind or along the direction of the slope, across an erosion-susceptible surface. The shorter the distance, the less severe erosion will be.

Stripcropping is of two general

types—strips running along the contour of the land and known as contour stripcropping, and straight strips running as much as possible at right angles to the prevailing wind and known as wind stripcropping or wind stripping. The choice of one or the other system depends on whether water or wind erosion is more important. Contour stripcropping is often helpful in controlling wind erosion but wind stripping is less likely to help in controlling water erosion.

The following list of implements suitable for stubble mulching is divided according to operation (tillage, seeding, etc.):

TILLAGE

Fallowing and preparing land for seeding.—Sweep or specially equipped rod weeder, with limited use of disk and chisel implements if amount of crop residue is greater than necessary (figs. 9 and 10).

Firming soil or scattering bunched residue.—Rotary-hoe type of implement or skew treader.

Anchoring mulch and making it stand erect.—Disk packer (described under "Stabilizing and Managing Drifting Stands," p. 30).

SEEDING THROUGH RESIDUE

Small grain.—Hoe (or shoe) drill.

Row crops.—Narrow moldboard lister (fig. 11). This implement makes a clean furrow, in which the seed is planted, and distributes the residue between the rows to prevent movement of sand by wind.

Double disk flex planter. This implement disturbs residue very little; therefore, its use improves chances of maintaining the residue, if the residue is not too heavy and the drill can cut through it without plugging.

PLANTING SORGHUM IN LISTER FURROWS

Special lister seeder. This method of seeding buries residue and may result in severe wind erosion before the crop

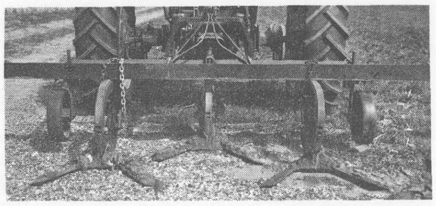

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***Figure 9.*—Tool - bar - mounted sweep implement with three 30-inch sweeps preceded by rolling colters to prevent dragging of residue. Note steel bar chained to frame to give sufficient weight for penetration of dry soil. (See fig. 10.)**

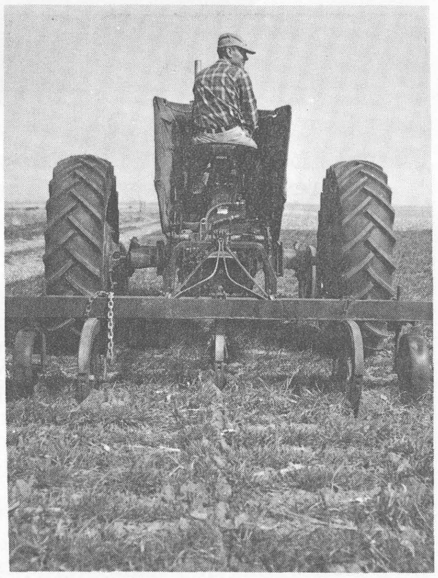

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***Figure 10.*—Same implement as the one shown in figure 9. Here, it is doing an excellent job of undercutting winter rye cover crop. It can be used to undercut any other kind of crop or stubble.**

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***Figure 11.*—Planting corn with narrow moldboard lister leaves plenty of residue between the rows to prevent sand from drifting.**

is high enough to protect the land from wind. Therefore, this method is recommended only in subhumid areas where wind erosion is less severe. Listing should normally be delayed until planting time in the spring if sufficient residue from the previous crop is available for erosion control.

CULTIVATING ROW CROPS PLANTED IN FURROWS

The first cultivation may be done with a skew treader, but standard cultivating equipment or a special implement equipped with 18-inch sweeps mounted on a cultivator beam is generally used for first and later cultivations (fig. 12). Metal shields may be used to prevent covering young plants.

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***Figure 12.*—Cultivating corn in stubble-mulched sandy soil with a special implement equipped with 18-inch sweeps mounted on a cultivator beam. When sweeps run under the residue, the trash does not interfere with operation.**

Emergency tillage may be desirable if there is not enough residue to control wind erosion. It is good only if it brings to the surface sufficient wind-resistant clods. Roughening the surface slows down wind velocity near the ground and helps to reduce erosion. Chisels are sometimes effective on sandy loam soils. Listing is generally more effective than chiseling, but is more expensive.

Listing should be regarded as a last resort. If listing becomes necessary, the tillage will be more effective on sorghum stubble if the stubble is left standing in the tops of the ridges instead of being covered.

After the crop is harvested, leave the stubble standing during winter and early spring to protect the soil.

Allowing grassy weeds to grow between the rows of cultivated crops in late season helps control wind erosion. It may provide all the cover needed in the fall, winter, and early spring.

Apply fertilizers wherever and whenever they are needed. In sandy areas, response of crops to fertilizer and lime differs greatly—even from farm to farm—and it is difficult to determine merely by observation whether crops will respond to them. To determine whether your soil needs fertilizer and lime, send soil samples to a soil-testing laboratory, usually located at a State experiment station or State university. Your county agent can furnish instructions for taking the samples and will help in interpreting the test.

Terracing and contour tillage are valuable on some sandy soils. Terraces are constructed across slopes to intercept, store, or divert runoff water before it gains sufficient volume and velocity to erode the soil. The type of terrace to which this bulletin refers consists of a channel constructed across a slope at regular intervals. On the downslope of the channel is a ridge.

Contour tillage is tillage across slopes to provide furrows and ridges, which reduce runoff and erosion by catching and holding water and storing it in the soil.

The following comments are devoted to the nonirrigated conservation cropping practices suited to the areas named.

Northern Semiarid Area.—Continuous cropping is the preferred method of growing grain on loamy sands and sandy loams in this area; it gives better protection from wind erosion than rotation of crops with fallow.

Better-grade sandy loams may be fallowed, but only if the fallow is in strips not exceeding 10 rods in width and the surface is kept covered with crop residue.

In the northern part of the area, continuous cropping with small grains is a common practice. Here, fall rye is especially useful because of its effectiveness in controlling weeds.

In the eastern part, many farmers rotate early-maturing corn with wheat and other small grains. Corn is grown for forage or grain and is a partial substitute for fallow. Strips of corn should alternate with strips of small grain. They should be no wider than 5 rods on loamy sands and 10 rods on sandy loams.

There is no need for stripcropping land on which erosion-resistant crops, such as cereals or grasses, are grown continuously. All tillage on sandy soils in this area should be of the stubble-mulch type.

Phosphorus is somewhat deficient in much of the area.

Nitrogen is seldom deficient under dryland management, except on stubble land in the eastern part of the area.

Lime is not needed.

In dry years, little benefit is derived from any commercial fertilizer.

Terracing and contour tillage are impractical on most sandy soils in this area, because of low rainfall.

Northern Subhumid Area.—The main crops on loamy sands and sandy loams in this area are—

- Wheat, oats, barley, rye.
- Corn (suited only to the better sandy loams).
- Soybeans.
- Flax.
- Forage crops (sweetclover for short rotations and grass-alfalfa mixtures for longer rotations).

Corn is generally used in place of fallow. Fallowing should be avoided because of the hazard from wind erosion. Corn should be planted in strips not exceeding 10 rods in width and alternated with equal-width strips of cereal or forage crops.

Stubble mulching is less common in the eastern part of this area than in other parts. The eastern part is more humid, and temperatures are lower there. These conditions make it more difficult to kill weeds with stubble mulching.

Phosphorus is somewhat deficient in most of the area. It is beneficial when applied, especially on fallowed land.

Nitrogen is deficient on stubble land and is usually beneficial when applied there.

Potassium is deficient on some sandy soils; especially good response may be obtained from potatoes.

Lime is seldom needed.

Terracing and contour tillage are seldom needed, because water erosion is seldom a serious problem.

Central Semiarid Area.—In the southern part of the area, the wind erosion hazard is great, and there is almost no fallowing even on sandy loams. The principal crop is sorghum grown on the land continuously. Secondary crops are broomcorn, corn for forage, and sudangrass for seed. Little wheat is grown.

There is less wind erosion hazard in the northern part of the area. Here fallowing is practiced in narrow strips, coupled with stubble mulching, on the better sandy loams, and more wheat is grown. A little sweetclover is grown too.

Because so few crops are adapted to the sandy soils, rotation of crops is seldom tried. Rotation of grasses and grain crops is possible in the northern part of the area; but it is not practical in the southern part, because of the difficulty of establishing grass.

Stubble mulching is the key to wind erosion control in this area. Although subsurface tillage implements are well suited to sandy soils in the area, they are little used except in the northern part.

The usual one-crop system with no fallow in this area makes stripcropping impractical.

Phosphorus, nitrogen, and potassium are usually sufficient on dryland soils in this area.

Lime is generally not required.

In some places, liming is required to grow sweetclover.

Some response to nitrogen is obtained in years of above-normal precipitation, especially on sorghum.

Terracing and contour tillage are practiced in a few sections where land is rough, principally in eastern Wyoming and western Nebraska; they are not needed elsewhere.

Central Subhumid Area.—In Nebraska the main crops on loamy sands and sandy loams are winter wheat, corn, sorghum, soybeans, alfalfa, sweetclover, hairy vetch, fall rye, oats, barley, and tame grasses. In the Great Bend area of Kansas, main crops on those soil classes are winter wheat, sorghum, sudangrass, and millet; minor crops are corn and sweetclover.

Following are some of the cropping systems that are adaptable to the area:

NORTHERN PART

Corn, oats and legume (vetch or sweetclover).

Corn, rye and vetch.

Corn, oats or barley, rye and vetch.

Corn, corn (fertilized), rye and vetch.

Corn, oats (fertilized), rye and vetch.

SOUTHERN PART

Wheat, row crop (sorghum or corn), rye and vetch.

Wheat, wheat, row crop, row crop, 4 years of alfalfa.

Fallowing is avoided because of the wind erosion hazard.

Stubble mulching is especially desirable on sandy soils in this area.

In growing legumes, try to grow large crops; use fertilizers. A special purpose of growing large crops is to provide abundant residues.

A variety of crops available in this area makes stripcropping an excellent practice. The strips preferably should not exceed 5 rods in width on loamy sands and 10 rods on sandy loams.

Phosphorus fertilization is needed on all crops.

Nitrogen is deficient. Legume crops should be grown in rotation with nonlegume crops.

Potassium is needed in some localities.

Sulfur and zinc are deficient in some localities.

Lime is deficient on cultivated land in most of the area. Liming is not required on grasslands of the Nebraska sandhills.

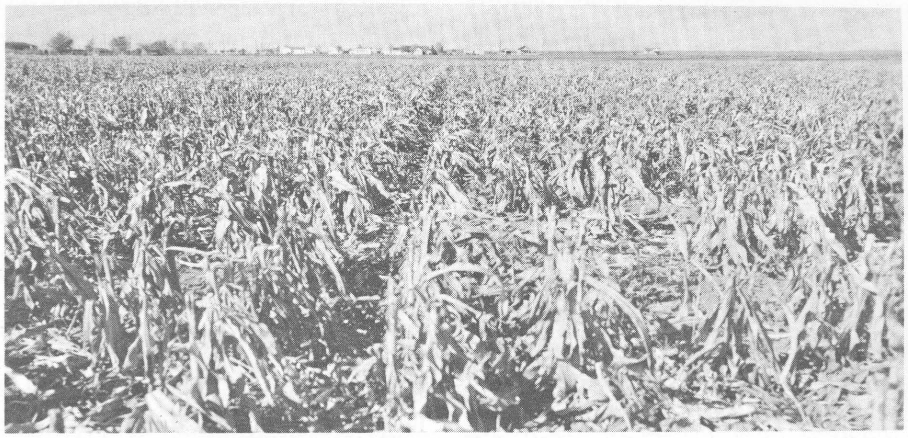
Terracing and contour tillage are needed on steeper sandy loams. Terraces should be seeded promptly with a crop that will give complete cover; rye and vetch are excellent for this purpose. The residue should be left on terrace ridges until the next crop is well started.

Southern Semiarid Area.—Cotton and sorghum are the only cultivated crops of commercial importance in this area. Minor crops include cowpeas, peanuts, sudangrass, guar, and watermelons.

Small grains are not well adapted to this area but are grown in localities where irrigation water is available. They can be grown as a winter cover crop—rye is especially good. A small grain crop can be grown alone or in combination with vetch.

Fallowing is impractical because of soil erodibility, high temperatures (which cause rapid evaporation of moisture from the soil), and high winds.

Grain sorghum is recommended for stubble mulching in this area because it produces a large amount of residue (figs. 13 and 14).



BN–14663

Figure 13.—Excellent residue remaining after combining Early Hegari grain sorghum on fine sandy loam soil. Total air-dry residue: 3,800 pounds per acre. (See fig. 14.)

BN–14662

Figure 14.—Same area as the one shown in figure 13. The photograph was taken in May of the succeeding year—after the winter and spring blow seasons and after heavy rains in early May. The area had been chiseled once for soil conditioning and swept twice for weed control. No wind erosion has occurred.

Grow sorghum as frequently as is necessary to control wind erosion. On loamy sands this may be continuously, and on better grade sandy loams 2 years in 3 or 3 in 4. Plant the crop in rows not more than 20 inches apart (figs. 15 and 16). The stubble must be in narrow rows and must be standing during winter and early spring to give maximum protection against wind erosion.

The usual cropping practice in this area is to grow cotton on the better soils (mostly sandy loams) and sorghum on the poorer soils (mostly loamy sands). When Government acreage controls are not in effect, entire farms are often planted to cotton. This practice makes wind erosion control extremely difficult.

Acreage controls on cotton have led to changes in cotton-planting practices, and these changes have possibilities of reducing the wind erosion hazard.

Cotton gives little residue cover for protection against wind erosion, and therefore is not suited to sandy erodible soils of the southern semiarid area. In attempting to obtain protection from wind erosion after the cotton crop is harvested, growers cut the stalks with a rolling stalk cutter or rotary shredder, then bed the land with a lister; they perform no other tillage until weeds begin to grow in the spring; at this time they relist or use knives for weed control.

Phosphorus and nitrogen are generally deficient in this area. However, response of plants is not great enough to make fertilizing practicable on dryland sandy soils. Fertilizers are necessary on all irrigated soils coarser than fine sandy loam.

Potassium may be deficient on extremely sandy soils.

Liming is not required.

Terracing and contour tillage are seldom practiced in the western part of this area, because slopes are generally slight; they are more common on steeper slopes in the eastern part. Contour tillage should be practiced more widely in this area, even on many of the slight slopes. Terraces are recommended only where the subsurface soil is heavy enough to form a stable terrace.

Southern Subhumid Area.—The main cash crops are cotton and sorghum. Small grains and peanuts are grown extensively in some parts of the area.

Stubble mulching is needed in this area to control both wind and water erosion. Maintain at all times as much crop residue on the soil surface as possible.

Wind stripping is particularly desirable where peanuts are grown. Sorghum is best for this purpose, since it can also be used as a cash crop. The common row system is two rows of sorghum alternating with two to eight rows of peanuts. These narrow strips are best under most conditions, but wider strips of sorghum may be needed if the soil is exceptionally erodible and the field is large.

Soil fertility is very low on sandy soils in this area. All cultivated crops respond to fertilizer. However, use of commercial fertilizers is not always profitable, because in dry years soil moisture limits crop yields, regardless of whether crops are fertilized.

Water erosion hazard makes contouring and terracing important in this area. Contouring should be practiced on all cultivated land. Terraces are recommended only where the subsoil is heavy enough to form a stable terrace.

BN–14666

Figure 15.—**Forage sorghum stubble in 40-inch rows on a fine sandy loam soil. Note soil movement between rows. (See fig. 16.)**

BN–14667

Figure 16.—**Area adjacent to the one shown in figure 15. The forage sorghum stubble is in 20-inch rows. No soil movement has occurred.**

Deep Plowing

Since about 1945 many farmers in the central States have followed the practice of plowing sandy land to a depth of 20 to 30 inches.

The primary purpose of deep plowing is to bring enough clod-forming subsoil to the surface to reduce wind erosion. The clay in the soil forms clods. But clods alone will not control wind erosion. Conservation cropping systems, already described, are also necessary.

Requirements and limitations to be observed when deep plowing for cultivated crops are as follows:

1. Only these kinds of sandy soil should be deep-plowed: Loamy sands and sands with subsurface soil that is within reach of the plow and contains at least 20 percent—but not more than 30 percent—of clay. Areas with less than 20 percent of clay in the subsurface soil should not exceed about 10 percent of the total area to be plowed.

2. Soils containing only a few inches of sand over fine-textured subsurface soil should not be deep-plowed.

3. One-fourth to one-third of the furrow slice must consist of fine-textured soil. This makes it necessary to plow at least 20 inches deep where the surface soil is not more than 15 inches deep and the subsurface soil contains at least 20 percent of clay.

4. The subsurface soil should be fairly granular and permeable, and should contain not more than 2 percent of calcium carbonate. More than 2 percent of calcium carbonate makes the soil extremely susceptible to wind erosion.

5. Plowing should be in a solid block—not in a strip pattern.

6. Sandy hummocks should be leveled before deep plowing so that the plow will get down to the fine-textured layer.

7. The plow should completely turn the furrow slice. (If a disk plow is being used, the diameter of the disk must be at least twice the required depth of plowing.)

Deep plowing of sandy soils in land classes III and IV, in preparation for growing cultivated crops, is a good practice if the above-mentioned requirements and limitations are kept in mind. If these are ignored, the practice may give negligible benefits, or may be harmful.

Adherence to proper conservation cropping practices.—Deep plowing the above-mentioned kinds of sandy soils brings up organic matter that is present in the finer-textured subsurface soil. As a result, yields of crops increase considerably the first year. But if inadequate conservation cropping systems are used, wind erosion occurs, the organic matter is steadily reduced, and yields fall back within a few years to where they were before the first deep plowing. Moreover, wind erosion removes the clay from the surface soil and leaves a layer of sand as deep as the depth of plowing. This condition is extremely harmful for further crop production.

Sandy soils in land classes V, VI, and VII should not be deep-plowed unless they meet the requirements and limitations of deep plowing and are to be returned immediately to permanent vegetation. Deep plowing is very effective in getting sands and loamy sands established to a permanent grass cover.

If improved conservation cropping systems are not adopted after land is deep-plowed the first time, deep plowing can be one of the worst forms of soil mining. The safest course is to deep-plow only those sands and loamy sands that are to be placed under irrigation or those that are to be returned to permanent vegetation.

Irrigation

The risk of crop failures due to wind erosion and lack of soil moisture is greater in the semiarid region than in the subhumid region. Therefore the need for irrigation is greater in that region.

In parts of the semiarid region where irrigation of sandy land is a practical matter, farmers and ranchers should consider its advantages. Those who are not interested in a complete system may wish to install a limited system—for example, one that would insure production of forage, seed grain, and fruit and vegetables.

In the subhumid region, irrigation may be useful for carrying growing crops through short periods of drought.

For individual farm developments, water is taken from small reservoirs or from wells. Community developments require water stored in large reservoirs or in streams.

The three main methods of irrigation are check basin (border), furrow, and sprinkler. Choice is based on soil, topography, and cost.

In general, sprinkler irrigation is the most suitable system for sandy soils. This system allows uniform penetration of water into the soil and reduces the danger of erosion by runoff water. On sandy soils with a fine-textured subsurface soil not more than 2 feet below the surface, furrow irrigation is quite satisfactory. Check basin and furrow irrigation systems are not adapted to deep sandy soils (deep sands and loamy sands).

Among the crops that respond well to irrigation on sandy soil are corn, beans, potatoes, cotton, sorghum, hay, and pasture. Shallow-rooted crops, such as hay and pasture, require more frequent irrigation than deeper-rooted crops.

Irrigation usually causes more rapid depletion of soil fertility. Irrigation farmers should use commercial fertilizers and, when they are available, barnyard and green manures. They should also use a crop rotation, and include legumes in the rotation.

For full information on irrigation development and practice, see your county agent or the local technician for your soil conservation district.

Shelterbelts

The words "shelterbelts" and "windbreaks" are used often to mean one and the same thing. They include, among other things, trees and shrubs that are high and dense enough to reduce wind velocity and trap drifting snow (fig. 17). Only trees and shrubs are considered in this bulletin. They aid in protecting soil from wind erosion and in conserving soil moisture in areas where there is enough snow to trap. They also shelter farmsteads and farm animals from severe winds and drifting snow and soils.

Sandy soils, except extremely deep sands, are well suited for growing trees and shrubs. Moisture in these soils is more evenly distributed to a greater depth than in fine-textured soils; this makes it possible for trees and shrubs to develop

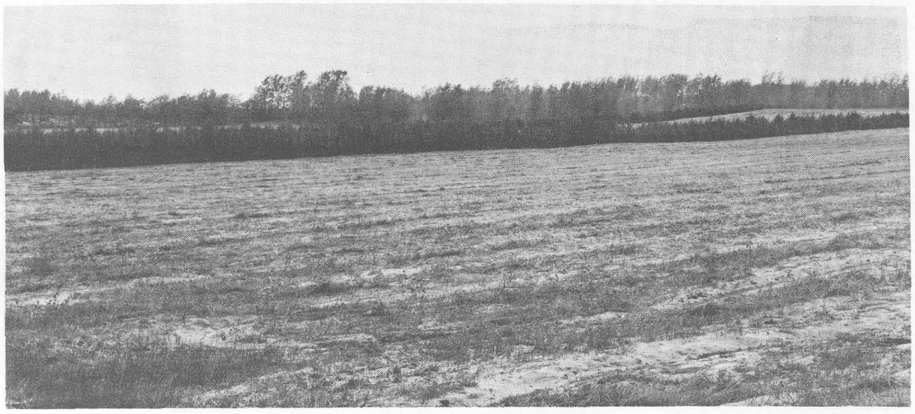


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Figure 17.—**Tree shelterbelts aid in protecting soil from wind erosion in subhumid areas. Vegetative cover is required for additional protection.**

deep, extensive root systems. Many sandy soils are underlain with fine-textured soil; these sandy soils are almost ideal for windbreaks and shelterbelts.

Field shelterbelts may be single row or multiple row. Single rows have several advantages:

- They require less land.
- They are easier to maintain.
- They allow snow to spread out over cropland, whereas multiple rows may cause snow to pile among the trees.
- They provide, for the same number of trees, more areas of food and cover for wildlife.
- They allow farmers to cultivate and kill weeds close to the trees.

A disadvantage of single rows is that their effectiveness depends on having a nearly perfect stand. Any dead trees or shrubs must be replaced.

On sandy soil, intervals of 20 to 40 rods between field shelterbelts are common, but these are too great to give complete protection from wind erosion. For complete protection, the intervals have to be so narrow as to be impractical. Therefore, field shelterbelts on sandy soil merely supplement stubble mulching and other practices for wind erosion control.

Only hardy, drought-resistant trees and shrubs can grow on sandy soils of the central United States. For information on suitable species, planting, and maintenance, write or see your county agent, the local technician for your soil conservation district, or the extension forester in your State.

The semiarid region is generally too dry for field shelterbelts. Where water is available, or with proper spacing and cultivation, trees and shrubs can be grown as windbreaks to shield farmsteads from wind and drifting soil and sand.

Over two-thirds of the sandy soils in the subhumid and semiarid regions are in native and tame grasses. Most of the grass is used for grazing; some is used for hay.

The objectives of pasture management are to—

- Obtain maximum, sustained production.
- Conserve soil and water.

To achieve these objectives, ranchers should determine proper stocking rate, and should learn to make adjustments in the rate, from season to season, by watching degree of use.

Note.—Ranchers can obtain information on pasture management and stocking rate from their county agents and local soil conservation district technicians. Also, standards by which to determine best use of forage are available.

Before degree of use becomes too great, animals should be moved to another pasture, given supplemental feed, or sold. To distribute grazing properly, a rancher should give attention to placement of salt and to location of water; he may need to build cross fences.

Grass and other forage crops provide excellent wind erosion protection for sandy soil.

The best treatment for the poorer sandy soils (all sands and deep loamy sands) is to seed them to permanent cover of grass or grass-legume mixture for use as pasture or as a hay crop.

Rangelands

Land in capability classes V, VI, and VII that is in cultivation (see table, p. 4) should be seeded to permanent grass. These classes of land are suited only for grazing; they are too erodible for continuously high crop production.

In preparing to seed grass, seed a cover crop. Do this during the growing season prior to fall or spring seeding of grass. If so much cover is produced that it becomes a hindrance in establishing grass, cut about 12 inches high and remove the tops, or partly graze off. Mow the cover crop when necessary to prevent it from producing seed so there will be none to germinate and smother the grass seedlings.

In fall or spring, plant grass into the cover crop (fig. 18). Make sure the cover crop is dead at the time of seeding grass. If weeds are present, kill them by spraying with 2,4-D unless cotton is growing in the locality.

If weeds come up after grass seedlings have emerged, mow them, but mow high—make sure not to clip off more than one-half of the height of the grass seedlings.

Many native and introduced grasses are suited for rangeland seeding on sandy soils. They include:

NORTHERN AREAS

Big bluestem, indiangrass, little bluestem, prairie sandreed, sand bluestem, switchgrass, western wheatgrass, needle-and-thread.

Crested wheatgrass and Russian wildrye are among the grasses suited for increasing production of rangelands.

CENTRAL AREAS

Big bluestem, blue grama, indiangrass, little bluestem, sand bluestem, sand lovegrass, sideoats grama, switchgrass, western wheatgrass.

SOUTHERN AREAS

Blue grama, buffalograss, green sprangletop, indiangrass, little bluestem, plains bristlegrass, sand bluestem, sand dropseed, sand lovegrass, sideoats grama, switchgrass.

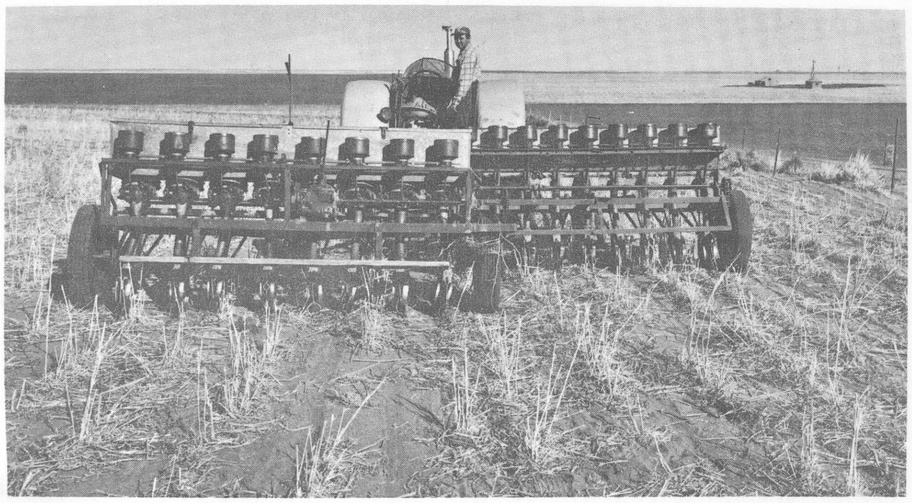

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Figure 18.—**Drilling grass seed directly into residue-covered surface. The residue consists of dead sudangrass stubble and dead weeds.**

The seeded grasses must be carefully managed to allow other, more desirable native grasses to come in.

Tame Pastures

The following comments refer to some of the grasses and forage crops suited for tame pastures on sandy soils.

GRASSES

Blue panicum, Johnson grass, and bermudagrass.—Adapted to southern areas; make excellent tame pastures with proper management. Bermudagrass makes good permanent pasture if fertilized.

Caucasian bluestem.—Adapted to the central and southern areas.

Smooth brome.—Suited to northern and central subhumid areas.

Crested wheatgrass, intermediate wheatgrass, and Russian wildrye.—Suited to northern semiarid area and to most of the central semiarid area.

Sudangrass.—Adapted to most of the central United States, but especially suited to the southern areas. Useful in checking wind erosion. Seeds germinate quickly and plants make rapid growth. Crop can be used as emergency hay or pasture crop or as dead cover in which perennial grasses can be seeded.

FORAGE CROPS

Alfalfa.—Suited to all of the subhumid region and to irrigated sections of the semiarid region. Can be established easiest in late summer.

Oats and other cereals.—Suited to the northern semiarid area. These make good annual forage crops.

Sweetclover.—Adapted to most of the central United States if moisture is adequate for establishment.

Vetch.—An excellent legume in the central and southern subhumid areas. Volunteers to some degree in rotation with other crops. Vetch and rye make a good combination for tame pasture; also, the combination makes a winter cover crop for erosion control.

Tame pasture can be reestablished more easily than permanent rangeland. Therefore, overgrazing of tame pasture may be warranted during a period of feed shortage or by need to protect rangeland—but overgrazing is not warranted if it might create an erosion hazard.

STABILIZING AND MANAGING DRIFTING SANDS

Bare, drifting sands and sand dunes are much more difficult to stabilize than cultivated soils.

These sandy areas are usually very rough and hummocky. Before stabilization steps are taken, it may be desirable to smooth the crests of dunes with a dragpole or bulldozer. But full-scale leveling at any stage is not advisable; it increases the difficulty of stabilizing the sand.

Stabilizing drifting sands is best accomplished during periods of the year when rain is most plentiful and wind velocity is lowest. Begin working the land on the side from which the prevailing wind blows; for example, begin on the north side if the prevailing wind is from the north.

Where the sand accumulation is shallow (not over 4 inches), the first step is to work the land with a deep-furrow cultivator or a lister. A deep-furrow cultivator is satisfactory in shallower accumulations of sand and a lister on deeper accumulations. These implements should penetrate deep enough to bring some clods to the surface.

The next step is to seed the land to broomcorn, sudangrass, or a small grain (such as rye), which will serve as temporary cover. Later, seed the land to a species of grass that is suitable for permanent cover. Seed directly into the temporary cover after it has died.

On deep sand accumulations (over 4 inches) the following method is generally effective. It has two phases—temporary and permanent stabilization.

Temporary stabilization is accomplished by covering the whole surface with mulch and anchoring the mulch so that it will not be blown away.

The following shows suitable mulch materials and the amounts that should be spread on the land.

MATERIAL:	*Tons per acre*
Prairie hay	2 to 2½
Wheat straw	2½ to 3
Corn fodder	4 to 5
Sorghum fodder	4 to 5

A blower-type spreader or a converted manure spreader can be used to spread the mulch uniformly, and a packer of the straight-disk type with cutaway disk edges is recommended for anchoring it. The disks should be spaced about 8 inches apart. The packer should be equipped with depth-gage wheels to control disk penetration.

Brush can be used instead of mulch. Apply by hand enough to stop movement of sand by wind.

Permanent stabilization consists in planting the mulched or brushed areas to permanent vegetation, which may be grasses, shrubs, or trees (figs. 19 and 20). The objective is to establish vegetation of the type that naturally prevails in the locality. Inquire from local authorities what grasses, shrubs, or trees are most suited to your land.

Grass is native vegetation in most of the central United States. The best way to plant grass seed is to drill it into the mulch with a drill designed for this purpose. Broadcasting the seed is less satisfactory but will be necessary on rough land and on land covered with brush.

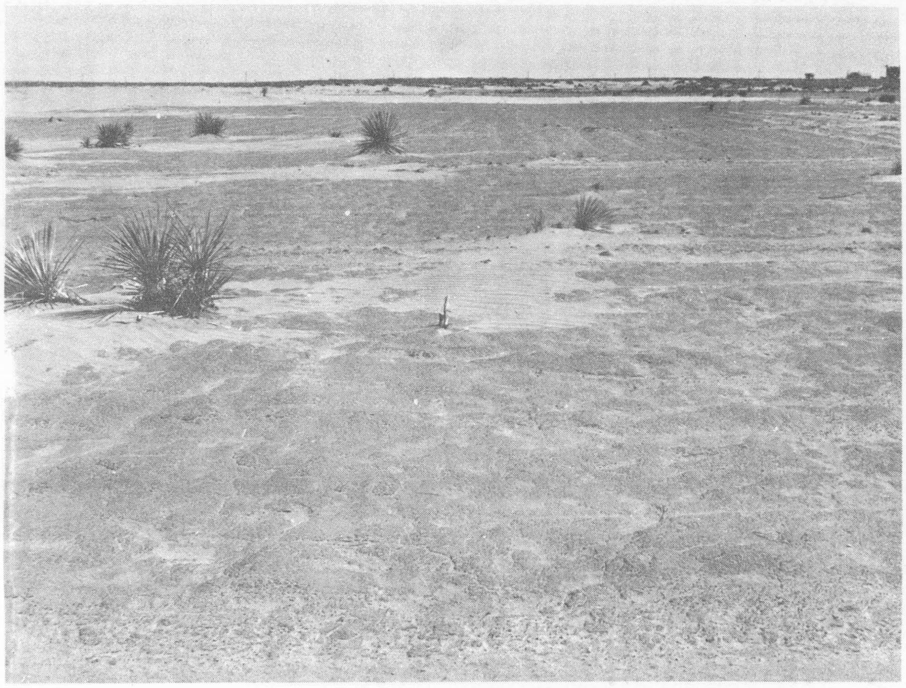

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Figure 19.—Sandy area badly blown by wind and not suited for cultivation. The photograph was taken in Morton County, Kans., in 1938. (See fig. 20.)

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Figure 20.—Same area as the one shown in figure 19 (photograph taken in 1942). The reclaimed area is maintained as permanent grazing land under the Bankhead-Jones Farm Tenant Act of 1937.

If shrubs or trees naturally prevailed, or prevail, in the area, plant them for permanent stabilization.

After drifting sands have been stabilized, careful management of the land is necessary.

- Trails and roads should be covered with nonerodible material, such as gravel.
- If there is grass, it should be protected from overgrazing; the land should be fenced.
- If there is woodland, it should be protected from fire (such as with fireguards) and from excessive cutting of trees.
- Homes should not be built on the land.

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