AGRICULTURAL EXPERIMENT STATION

KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE

MANHATTAN, KANSAS

TILLAGE PRACTICES FOR SOUTH-WESTERN KANSAS

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SUMMARY

Timely and proper cultivation to keep down weed growth is the most important method of conserving soil moisture. Fall or early spring breaking of the soil for row crops is preferable to late spring breaking.

Planting in furrows of medium depth is best for listed row crops. Row crops planted in deep listed furrows are slow in starting and likely to be covered by soil washed from the ridges.

Sorghums average higher annual yields when planted with furrow openers on a surface planter than when listed.

Kafir and milo should be planted as near June 1 to 10, and feterita as near June 15 to July 1 as soil and weather conditions will permit. Forage sorghums can be planted up to June 15 to 20 and maximum yields secured.

Fallow has increased the average yield of kafir 77 to 92 per cent, milo 75 per cent, sorgo forage 77 per cent, and wheat 87 per cent, over the best method of continuous cropping.

Fallow stabilizes farm incomes by making possible the production of a crop in dry years when crops fail on continuously cropped land.

Proper tillage practices for the successful production of crops in southwestern Kansas must meet several requirements; namely, permit rapid absorption of rainfall, prevent run-off, control weed growth, and provide for a seed bed of good tilth. These factors all equal "the conservation of moisture for the growing crop." The use of power machinery in recent years has enabled the farmers of this section of Kansas to do a more thorough, timely job of seedbed preparation and to meet the above requirements on a large-scale operation better than was possible when horse-drawn implements were used exclusively.

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TILLAGE PRACTICES FOR SOUTHWESTERN KANSAS[1]

R. L. VON TREBRA[2] AND F. A. WAGNER

Since 1908 the office of Dry-land Agriculture, United States Department of Agriculture, has been cooperating with the Garden City branch of the Kansas Agricultural Experiment Station in studying various methods of seed-bed preparation, tillage practices, rates and dates of planting, and other related phases of crop production as they apply to southwestern Kansas.

It is the purpose of this bulletin to condense and summarize some of the information gathered during that period and present it to the farmers of southwestern Kansas. During this time some rather definite results have been obtained from different methods and practices with which the average farmer is thoroughly familiar. While not all tillage practices discussed herein are to be found on all farms, they are in operation more or less on the farms of southwestern Kansas. Certain methods and practices have been found superior to others in producing results, though that does not mean that all farmers should adopt one definite method for the production of a given crop. Each individual farmer has his own tillage problems and the satisfactory solution of those problems will be determined by his own needs.

SOIL AND CLIMATE

The soil on the Garden City Agricultural Experiment Station is a silt loam, and is typical of most of the heavy upland soils in southwestern Kansas. There are also important areas of sandy loam to be found in rather scattered sections over most of the southwestern part of the state. The principal areas of this type border the Arkansas river on the south and are adjacent to the Cimarron river and the principal tributaries in Stanton, the southern part of Grant, Morton, and Stevens counties.

The climate is relatively uniform over all southwestern Kansas.

The average annual rainfall at Garden City for the 24-year period from 1908 to 1931, inclusive, was 18.63 inches. Seventy-five per cent of the rainfall occurs during the summer months. (Fig 1.) Most of

Acknowledgment.—The authors are indebted to officials of the Department of Agronomy of the Kansas Agricultural Experiment Station, and Dr. C. E. Leighty, principal agronomist in charge, and John S. Cole, senior agronomist, both of the office of Dry-land Agriculture, for their helpful suggestions and criticisms in preparing this publication.

1. Contribution No. 47 from the director's office. The experiments reported in this bulletin were conducted by the Garden City branch of the Kansas Agricultural Experiment Station and the Office of Dry-land Agriculture, United States Department of Agriculture, cooperating. The following men of the Office of Dry-land Agriculture have had immediate charge for the periods indicated: H. R. Reed, 1907 to 1910; Ralph Edwards, 1911 to 1912; J. G. Lill, 1913 to 1914; C. B. Brown, 1915 to 1917; F. A. Wagner, 1918 to 1919; F. E. Keating, 1920 to 1921; E. H. Coles, 1922 to 1928; and R. L. von Trebra, 1929 to 1932.

2. Agent, Office of Dry-land Agriculture, Bureau of Plant Industry, United States Department of Agriculture.

this summer rainfall occurs as hard, dashing rains. It is not uncommon for 1½ to 2 inches of water to fall during an interval of 30 to 60 minutes. Rains that occur in this manner frequently have a heavy run-off and a large amount of moisture is lost. Under such conditions it is essential that proper tillage practices be used to prevent such run-off and conserve as much moisture as possible for crop production.

The average frost-free period falls between April 30 and October

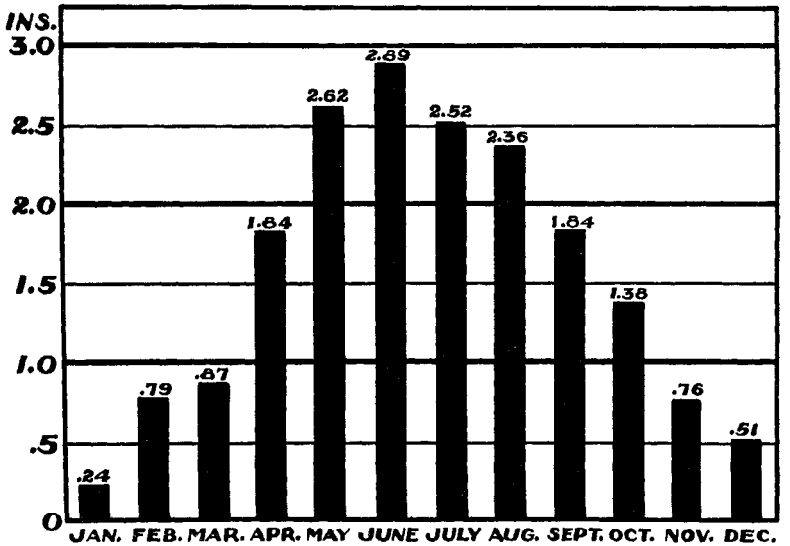

FIG. 1.—The average monthly precipitation in inches at the Garden City Agricultural Experiment Station, 1908 to 1931, inclusive.

12. This frost-free period is approximately 165 days and is sufficient for normal development and maturity of most crops.

SEED-BED PREPARATION FOR ROW CROPS

The value of early preparation of the seed bed When growing kafir, milo, or other sorghums continuously, has been clearly shown in seed-bed preparation experiments. No pronounced benefit has resulted from any one good method over another. The detemining factor has been the control of weed growth. Weeds use moisture that should be conserved for the crop and ,also make the preparation of a good seed bed difficult.

Importance of Controlling Weed Growth.—Experimental work at other stations has shown that plants use approximately 350 to 550 pounds of soil moisture to produce a pound of dry weight. It can readily be seen that a few weeds scattered over a field will remove an enormous quantity of moisture.

TABLE I.—ANNUAL YIELDS OF LISTER-PLANTED KAFIR AND MILO AT THE GARDEN CITY BRANCH STATION, 1921 TO 1931, INCLUSIVE.

Bushels per acre.

YEAR.	No cultivation before planting.		Cultivated before planting.	
	Kafir.	Milo.	Kafir.	Milo.
1921	22.3	21.0	29.5	18.3
1922	7.3	14.3	27.0	21.9
1923	13.3	16.7	13.7	20.2
1924	2.0	18.4	16.0	26.9
1925	.0	.0	12.0	3.1
1926	3.7	.0	11.2	21.4
1927	4.7	5.5	8.2	6.7
1928	22.8	36.9	24.2	39.1
1929	16.2	5.3	29.0	21.0
1930	.0	5.7	7.5	16.7
1931	26.8	22.8	24.7	33.3
Av. yield per acre	10.8	13.3	18.5	20.8

Table I illustrates the importance of cultivation to control weed growth. Four one-tenth-acre plots have been continuously cropped to kafir and milo since 1921. One plot each of kafir and milo has received no cultivation or preliminary preparation before planting with a lister, while one plot of kafir and one of milo had sufficient cultivation with a disk or duck-foot cultivator preceding planting to kill all weed growth.

The plot of milo that received no tillage before planting produced an average yield of 13.3 bushels and the plot of kafir produced an average of 10.8 bushels per acre. When the cultivation before planting was sufficient to control weed growth, the average yield of milo was 20.8 bushels and of kafir, 18.5 bushels per acre.

Time and Method of Seed-bed Preparation.—There are a number of practical methods of preparing a seed bed for row crops. The method of preparation used will and should depend somewhat on the type of equipment available on the farm. Breaking the ground by plowing, blank listing, or one-waying will give practically the same results.

The actual manner in which the work is done is not so important as the time. Methods which have produced the largest yields at the Garden City station required early breaking of the ground, preferably in the fall or early spring. Spring breaking should be done not later than April 1. Late breaking does not allow sufficient time for the seed bed to settle before planting. A late prepared seed bed is usually cloddy, full of air spaces, and generally in very poor

tilth. Early weed growth is often heavy enough to remove large quantities of soil moisture.

First Cultivation of the Seed Bed.—If the ground is broken in the fall, spring working should be started usually about the last of April or as soon as the first crop of weeds begins to grow. On fall listed or early spring listed ground the ridges should be leveled down at the time of the first tillage operation. The first weed growth of the season will also be destroyed at this time. If the ground was plowed or one-wayed the cultivation practice to follow should be one that effectively destroys weed growth and produces an open, cloddy surface that will readily absorb rainfall and resist soil blowing. The use of the spring-tooth cultivator, duck-foot cultivator, or one-way is very effective.

Second Cultivation of the Seed Bed.—About May 20 to May 25 the land will need a second cultivation before planting. This cultivation is probably the most important operation in seed-bed preparation for row crops. The second and largest crop of weeds will be destroyed at this time and no other cultivation, either before or after planting, has so much to do with the success of the crop. During wet seasons or seasons favorable to rapid weed growth, the ground will need more frequent tillage. Different seasons and soil conditions will determine the amount of cultivation needed in preparation for planting. The important object is to destroy all weed growth before planting and sufficient cultivation to accomplish this must be done.

PLANTING SORGHUMS

DATE OF PLANTING

Date-of-planting experiments with grain and forage sorghums were conducted at the Garden City Agricultural Experiment Station for the 9-year period, 1921 to 1929, inclusive. Some definite information was secured concerning the best time to plant various sorghums.

Table II gives the summary of results secured with Dawn kafir, feterita, Dwarf Yellow milo, Sumac sorgo, Red Amber sorgo, and Sudan grass. Plantings were made on four different dates, May 15, June 1, June 15, and July 1.

The highest average yields of kafir and milo were produced from plots planted during the first ten days of June as shown in Table II. If planted earlier, the plants usually started heading during the driest and hottest weather of the summer. If soil moisture is limited, recovery is difficult and light yields are not uncommon. When planted much later than this period the crop does not mature properly because of the shortened season and cool weather in September and October.

Feterita responds better to the later dates of planting than do the other grain sorghums. The highest average yield of feterita, 21.3 bushels per acre, was produced on the June 15 planting. The July

1 planting was next highest with an average yield of 19.7 bushels per acre. The first two dates of planting show a marked decrease in yields of grain compared to the two later dates.

TABLE II.—AVERAGE YIELDS OF SORGHUMS PLANTED AT DIFFERENT DATES AT THE GARDEN CITY AGRICULTURAL EXPERIMENT STATION, 1921 TO 1929, INCLUSIVE.

SORGHUMS.	Grain yield per acre.				Stover yield per acre.			
	May 15.	June 1.	June 15.	July 1.	May 15.	June 1.	June 15.	July 1.
Grain Sorghums.	Bus.	Bus.	Bus.	Bus.	Lbs.	Lbs.	Lbs.	Lbs.
Dawn kafir.....	15.2	18.4	16.2	11.1	2,452	2,682	2,678	3,134
Dwarf Yellow milo,	13.5	17.7	15.5	12.8	2,085	2,076	2,098	2,099
Feterita.....	11.9	15.9	21.3	19.7	2,416	2,256	2,044	2,121
Forage Sorghums.								
Red Amber sorgo..	.....	.....	.....	.....	3,772	3,945	4,327	3,783
Sumac sorgo.....	11.7	6.0	7.6	.....	5,676	6,896	6,823	.....
Sudan grass.....	.....	.....	.....	.....	5,804	6,192	6,248	3,364

Feterita will produce a better crop of grain than most of the other sorghums during extremely hot weather. It requires a shorter growing season than the other common standard grain sorghums and will mature a good crop when planted the latter part of June. These facts make it a good grain sorghum to use when replanting is necessary.

Forage sorghums planted before June 15 are likely to be so far advanced when the midsummer dry season comes that they will be greatly injured and unable to resume growth when fall rains normally start in August or September. When planted after June 15 they do not have sufficient time in which to mature. The habits of growth and response to date of planting of Sudan grass are very similar to that of other forage sorghums. Too early planting causes checking of early growth and slow development. When planted after June 20 Sudan grass is under the handicap of a short growing season.

SURFACE PLANTING VERSUS LISTER PLANTING

Farmers frequently experience difficulty in securing stands of sorghum when planted with the lister. This is especially true on the heavier types of soil. The bottom of the lister furrow after planting is very often cloddy and dries out rapidly, resulting in slow germination with many weak, spindling stalks that often die before becoming established, thereby resulting in poor stands. At times it is difficult when sorghums are planted with the lister, to secure a good seed bed with plenty of moisture for germination and sufficient soil to cover the seed properly.

In the discussion of climatic conditions, mention was made of the heavy, dashing rains which are the prevailing type of rainfall re-

ceived during the summer months. It is not an uncommon occurrence for lister-planted sorghums to be almost covered with soil washed from the lister ridge by hard rains. All sorghums are delicate and tender when growth starts. They are especially subject to damage by cold weather. Experimental work at other stations on the temperature of seed beds has shown that the soil in the bottom of a lister furrow is colder than the surface of the ridges. A cold seed bed may cause poor germination of the seed and weak plants that are unable to develop normally.

It has been the experience of successful farmers and the observations at this station that a better seed bed for sorghums is secured by nosing out furrows previously listed than by single listing. Shallow relisting in the old furrow leaves from one to two inches of warm, mellow soil that promotes quick germination and rapid growth.

Quicker germination and more uniform stands are produced when sorghums are planted with an ordinary surface planter than when listed. By equipping the runners of a surface planter with furrow openers it is possible to combine the desirable features of both lister planting and surface planting.

TABLE III.—YIELDS PER ACRE OF LISTER-PLANTED AND SURFACE-PLANTED KAFIR ON PLOTS CONTINUOUSLY CROPPED AT THE GARDEN CITY BRANCH STATION, 1913 TO 1931, INCLUSIVE.

	Lister-planted.				Surface-planted.			
Plot	1.	2.	3.	Av.	A.	B.	C.	Av.
1913	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1914	5.8	3.8	5.0	4.9	3.7	6.7	3.8	4.7
1915	25.0	3.7	15.0	14.6	27.7	31.7	27.3	28.9
1916	2.7	7.0	3.7	4.5	.0	.0	3.4	1.1
1917	.0	.0	.0	.0	.0	.0	.0	.0
1918	2.8	1.2	3.8	2.6	1.2	1.4	2.0	1.5
1919	19.0	17.2	17.3	17.8	24.2	31.2	32.5	29.3
1920	41.7	28.5	27.7	32.6	32.7	37.5	38.5	36.2
1921	22.2	26.0	25.5	24.6	16.5	17.7	27.0	20.4
1922	18.8	11.2	20.2	16.7	18.5	12.7	18.3	16.5
1923	11.5	15.0	12.3	12.9	19.7	21.3	23.2	21.4
1924	21.7	15.2	20.7	19.2	36.8	42.2	38.8	39.3
1925	7.0	6.7	7.0	6.9	3.2	2.5	2.0	2.6
1926	16.5	14.8	6.8	12.7	5.8	4.0	13.0	7.6
1927	9.8	5.5	5.2	6.8	11.0	6.8	8.5	8.8
1928	27.2	24.7	25.8	25.9	52.5	55.8	50.8	53.0
1929	25.3	19.2	22.2	22.2	17.7	14.2	10.7	14.2
1930	.0	.0	3.0	1.0	.0	.0	.0	.0
1931	35.2	33.5	28.3	32.3	39.3	34.2	46.5	40.0
Av. yield, bus. per acre				13.6				17.1

Tillage practices:

Plot 1. Fall listed; ridges cultivated in the spring and split at planting time.
Plot 2. Fall listed; ridges split at planting time in the spring.
Plot 3. Early spring listed; cultivated; relisted at planting time.
Plot A. Late spring plowed
Plot B. Fall plowed .....
Plot C. Fall listed .....
} Ground worked down and planted with a surface planter.

The annual and average yields of listed and surface-planted kafir from 1913 to 1931, inclusive, as given in Table III, indicate the advantage for surface planting of sorghums on the heavy soil of this area.

Surface-planted kafir averaged 3.5 bushels more per acre than listed kafir. The surface-planted kafir outyielded the listed kafir in eight of the thirteen years in which the kafir yield was more than five bushels per acre.

FALLOW FOR ROW CROPS

Row crops grown on alternate fallow have produced nearly double the average yields of those grown on continuously cropped plots with the best known methods of seed-bed preparation. Certain field operations that are necessary under a system of continuous cropping can be eliminated when row crops are grown under an alternate fallow and cropping system. These operations are: (1) Only one-half the area need be seeded and harvested each year; and (2) row cultivation, which is more expensive than fallow cultivation, is necessary on only half the area. Sorghums grown on fallow develop and mature better and more uniformly than those grown on continuously cropped land. Uniformity of maturity is especially important when the crop is to be harvested with a combine.

Over a period of nine years at the Garden City branch station kafir grown on fallow has produced an average increase of 16.1 bushels, or 92 per cent more grain per acre than when grown on fall-listed ground; and an average increase of 14.6 bushels, or 77 per cent more grain per acre than when grown on cultivated and lister-planted ground.

Over the same nine-year period, milo on alternate fallow has produced an average increase of 18.4 bushels, or 75 per cent more grain per acre than on land cropped by the highest average yielding method of continuous cropping.

An average of 77 per cent more sorgo stover was produced on alternate fallow than on continuously cropped land. The stover produced on fallow land was leafier, more rank, more succulent, and in every way superior in quality to that produced on land continuously cropped. Table IV gives the annual and average yields of kafir and milo grain and of sorgo forage on seed beds prepared by different methods at the Garden City station for a period of nine years, 1921 to 1929, inclusive.

TABLE IV.—ANNUAL YIELDS OF KAFIR AND MILO GRAIN AND SORGO STOVER IN SEED-BED EXPERIMENTS AT THE GARDEN CITY STATION, 1921 TO 1929, INCLUSIVE.

	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.	Av. yield.
					Bushels per Acre.					
KAFIR GRAIN.										
Fall listed; cultivated; relisted	27.8	19.2	12.5	22.2	5.8	6.8	5.2	32.3	25.3	17.5
Cultivated; lister-planted	29.5	27.0	13.7	16.0	12.0	11.2	8.2	24.2	29.0	19.0
Alternate fallow	16.2	35.5	23.2	46.0	34.3	28.5	27.7	42.5	48.7	33.6
MILO GRAIN.										
Early spring listed; cultivated; lister-planted	27.8	18.6	32.6	35.2	10.2	18.4	7.4	47.2	22.6	24.4
Cultivated; lister-planted	18.3	21.9	20.2	26.9	3.1	21.4	6.7	39.1	21.0	19.8
Alternate fallow	42.4	30.5	34.1	57.4	43.3	35.7	29.8	60.2	51.7	42.8
					Pounds per Acre.					
SORGO STOVER.										
Fall plowed	4,540	5,660	9,340	4,670	3,230	3,920	3,610	15,660	7,660	6,477
Alternate fallow	6,110	16,260	12,260	9,160	12,660	5,660	7,580	17,080	16,230	11,444

Weights: Kafir, 60 pounds per bushel; milo, 58 pounds per bushel.

SEED-BED PREPARATION FOR WINTER WHEAT

The average annual yields of winter wheat in southwestern Kansas for the past 20 years have ranged from practically nothing to exceptionally high. These variations have occurred even though the seed beds were prepared by good methods. The controlling factors affecting yields and causing such wide variation have been extremely favorable or unfavorable seasons for wheat production. The rainfall in southwestern Kansas is not sufficient to insure consistently high yields year after year, such as are commonly secured in central and eastern Kansas. High temperatures and hot winds frequently occur at a critical stage of maturity and often reduce a promising crop yield very materially.

The normally dry winter and early spring have considerable influence on the yields of winter wheat. This is especially true if there is a shortage of subsoil moisture at planting time. When wheat does not have sufficient soil moisture to maintain necessary growth, many plants die and others become weakened and will be unable to resume a healthy, normal growth when spring rains come.

Figure I illustrates the average seasonal distribution and amount of monthly rainfall. The monthly distribution of the rainfall and the manner in which it falls are important factors in determining the best method of seed-bed preparation for wheat. If the seed bed is not prepared early or if the surface is allowed to become fine and pulverized, a large amount of the heaviest rainfall of the season will be lost, either through weed growth or run-off. Land that is to be fallowed or cropped should be broken either in the fall or early spring before heavy rains normally occur. Plowed, listed, or one-wayed land will permit a better penetration of rainfall than unbroken land. When farming under conditions of approximately 18 inches of annual rainfall, the loss of three to four inches through run-off is a serious handicap in the production of a normal crop. The amount of soil moisture lost by evaporation is nearly constant year after year. All rainfall that can be retained in the soil over the amount lost by evaporation is available for plant use. It can readily be seen that any tillage practice that will reduce the run-off through greater absorption of the rainfall is valuable in storing moisture that otherwise might be lost.

Due to improved cultural practices and better methods of seed-bed preparation, southwestern Kansas has become one of the principal wheat-producing areas of the southern great plains.

Experimental work at this station has emphasized the importance of: Early preparation of the seed bed, later planting than the common practice with many farmers, and the necessity for better conservation of the soil moisture by proper tillage methods.

Late plowing has proved very unsatisfactory for continuous wheat production. It permits a large loss of soil moisture by allowing heavy weed growth after harvest. The seed bed resulting from late plowing is never in good physical condition. It is cloddy, loose, and in a general state of poor tilth.

Early plowing or listing has proved to be very satisfactory from the standpoint of conserving moisture and preparing a good seed bed. Average yields produced under these two methods are 25 to 50 per cent higher than on late plowing.

At intervals during the last 20 years, a considerable number of inquiries by farmers have been received relative to the advisability of breaking the subsoil immediately following the plowing operation. The theory advanced was that loosening the subsoil would increase the amount of moisture stored. However, experimental work at this station has not shown any benefit from subsoiling. After the subsoil has been broken it does not settle in time for seeding in the fall and air pockets exist that are detrimental to crop growth. Considering the extra expense of additional power and labor needed to perform the subsoiling operation, it has been more of a failure than a success.

Experimental work with the use of the one-way plow has just been started therefore, no conclusions can be made concerning its use at this time.

Table V shows the comparative annual and average yields of winter wheat on seed beds prepared by different methods. Wheat on spring-plowed fallow prohuced a 27 per cent higher average yield than on early listed ground, which to date has been the best method of seed-bed preparation for continuous cropping to wheat. Fall-listed fallow that was clean cultivated the following summer produced an average yield 87 per cent higher than the best method of continuous cropping.

Wheat stubble land that is to be fallowed and that has no volunteer wheat or weed growth in the fall is often left for breaking in the spring. Wheat stubble will catch and hold more snow and thus store more moisture than land that is broken. Usually a large amount of snow blows off land that is fall worked. Wheat stubble will retard run-off of rainfall sufficiently to prevent any large loss unless the slope is abrupt.

Probably the principal advantage gained by leaving a clean wheat stubble for spring breaking is the elimination of one cultivation. Spring breaking of ground for fallow should be done when the weeds first start growth in the spring. If the clean stubble is fall broken the first spring working for control of weeds will need to be done at about the same time as spring breaking should be done on clean stubble. The saving of one tillage operation is an important item in reducing the cost of production. Successful handling of fallow land will vary with conditions found on individual farms.

During average seasons the fallow method has produced consistently higher wheat yields than the continuous crop method. The advantages of summer fallow for wheat production are summarized as follows: (1) Storage of more soil moisture, (2) control of noxious weeds, (3) control of insects, such as false wire worm and wheat straw worm, (4) aid in preventing loss from some wheat diseases, (5) only one-half the area to be harvested and seeded each year,

(6) fewer tillage operations needed in preparing for one crop of wheat on fallow than two crops grown continuously, (7) better distribution of labor, and (8) stabilization of production.

TABLE V.—YIELDS OF WINTER WHEAT UNDER DIFFERENT CULTURAL METHODS AT THE GARDEN CITY BRANCH STATION, 1919 TO 1931, INCLUSIVE.

Bushels per acre.

YEAR.	Continuously cropped.				Alternate fallow.	
	Late plowed.	Early plowed.	Subsoiled.	Early listed.	Fallow, spring plowed.	Fallow, fall listed.
1919	17.3	21.0	19.5	22.5	19.8	26.0
1920	.0	.0	6.7	8.8	7.2	6.0
1921	3.8	8.8	5.8	6.2	11.2	20.0
1922	.....	.....	.....	.....	.....	.....
1923	.0	.0	.0	4.8	2.3	2.2
1924	14.0	21.0	17.3	23.2	23.0	26.3
1925	.0	.0	.0	2.5	12.5	24.7
1926	1.2	1.7	2.8	3.8	3.3	13.0
1927	.0	.0	.0	.0	.0	.0
1928	.0	.0	.0	.0	.0	.0
1929	12.6	18.8	18.0	16.7	26.2	32.9
1930	8.2	14.5	12.8	12.3	27.5	45.0
1931	21.8	26.2	24.3	23.2	31.7	35.2
Av., (12 years)	6.6	9.3	8.9	10.3	13.7	19.3

In 1922 a heavy yield was lost after harvest because of a high wind storm that mixed bundles from the various plots. The bulked yield from all plots was 15.2 bushels per acre. The averages given are for 12 years, 1922 being omitted.

The crop was hailed out in 1928.

DATE OF SEEDING

The optimum date for seeding wheat over a series of years has been found to be between September 20 and October 10. A large percentage of the wheat in southwestern Kansas is seeded too early for best results.

Too early seeding is especially harmful under conditions of a good supply of surface moisture in the fall and a dry, early spring. This condition causes a heavy fall growth which cannot be maintained by the small amount of spring subsoil moisture. Many plants die and those that are able to survive are in a weakened condition and do not produce normally. Yields of wheat on fields that have gone through the above conditions are usually low.

Wheat planted after October 10 normally does not have time to produce sufficient growth before severe winter weather and often produces weak plants, caused by insufficient root development. Such

plants are more susceptible to damage from soil blowing and, due to the poor root development, find it difficult to survive winter and early spring drouths.

SOIL BLOWING

Soil losses from blowing and the destruction by wind of growing crops just becoming established are losses that can be prevented or reduced by proper tillage methods applied at the right time. Fall-

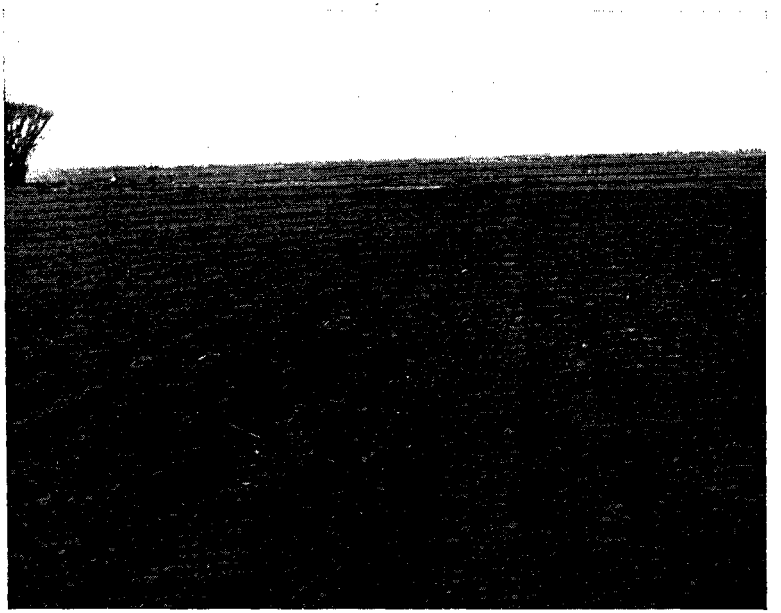

FIG. 2.—A fallow field cultivated with a duck-foot cultivator to prevent soil blowing.

plowed and one-wayed land that is to be planted to row crops the following spring is very susceptible to severe blowing in late winter and early spring. Surface cultivation with a duck-foot cultivator or the spring-tooth harrow, will roughen the surface of such land enough to prevent severe damage.

Fallows that go through the winter following previous summer cultivation are subject to severe soil blowing the following spring unless they are properly handled. The last cultivation in the fall for the control of weed growth should be done with an implement that leaves the surface ridged or rough and as cloddy as possible. The duck-foot cultivator with the shovels spaced from 16 to 20 inches apart is a good implement with which to produce such a condition. (Fig. 2.)

It is not unusual for some soil blowing to take place on wheat land that is only partially covered with wheat. Lister furrows, spaced at

intervals of 20 to 30 feet, will be found quite effective for avoiding any severe damage. A common argument against the use of the lister in this manner is that it leaves the field rough for harvest. After the wheat has made sufficient growth to prevent further blowing, the lister ridges should be worked down. This may be done by the use of a common five-tooth one-horse cultivator or by pulling an "A"-shaped drag, open end first, down the lister furrow. The problem of working down listed furrows is not an item of importance if by doing the listing a wheat crop is saved. Some farmers report having stopped soil blowing by using an ordinary duck-foot cultivator equipped with narrow spade-type shovels spaced 20 to 24 inches apart, and going over the entire field with this implement.

A common argument against fallow is the danger of soil blowing. Proper cultivation methods on fallow land will effectively prevent any great damage by blowing on most soils. In preparing fallows it is essential to keep the surface as rough and cloddy as possible. By using proper tillage methods with this principle in mind, the danger from soil blowing becomes of minor importance.

Damage from soil blowing often occurs before methods of control are started. The time to prevent soil blowing is before it starts. If a field goes into the winter in such condition that injury from blowing might take place, control methods should be practiced at once before the damage occurs. If soil blowing starts a certain amount of damage is usually done before it can be stopped.

Handling fields in such a manner as to prevent soil blowing would generally eliminate the large loss which often comes from practices designed to stop blowing.