Wide Row Planting of Small Grains

to Establish

Sweet Clover and Lespedeza

By Horace J. Harper

Bul. B-298 . . . OKLAHOMA AGRICULTURAL EXPERIMENT STATION . . . . . June. 1946

BUILDING SOIL FERTILITY WITHOUT REDUCING FARM INCOME.

The experiments reported in this bulletin indicate that wide row spacing of a small grain nurse crop provides a way to establish legume rotations to maintain or increase future yields without greatly reducing immediate farm income. The wide row method is being rapidly adopted in Oklahoma on the basis of verbal reports by county agents, soil conservationists, and others who have observed the experimental plots on the Oklahoma Agricultural Experiment Station farms. *It is reasonable to believe that this practice will be the key to a successful soil improvement program in central and eastern Oklahoma.* The method may also be applicable to other regions where lack of moisture limits the establishment of legumes in competition with a nurse crop of small grain.

Water is an important limiting factor in crop production in the subhumid portion of the Southern Great Plains area. However, soil organic matter is gradually decreasing as a result of the continued production of soil-depleting crops and must eventually be replaced if crop yields are to be maintained at as high a level as climatic conditions will permit. Systematic crop rotations with legumes will maintain the nitrogen content of the soil east of the 99th meridian if provision is made for the successful growth of a legume crop to be used for soil improvement.

CONTENTS

Wide Row Planting of Small Grains to Establish Sweet Clover and Lespedeza

By HORACE J. HARPER
Agronomist, Soils

Legume rotations are needed on many farms in central and eastern Oklahoma[1] to provide nitrogen and organic matter for soil improvement. Soil-improving rotations can be started without serious loss in immediate income if sweet clover or lespedeza are seeded in a nurse crop of small grain, but these legumes often fail when sown in small grain planted in the usual 7- or 8-inch drill rows. The legume seedlings cannot obtain sufficient water to survive in competition with the grain when rainfall is limited around harvest time.[2]

The solution to the problem of obtaining a good stand of sweet clover in a nurse crop of small grain during a dry season is to plant the grain in 14- or 16-inch rows by covering every other opening in the drill box. Tests made by the Oklahoma Agricultural Experiment Station over the past 16 years show that a greater distance between grain rows reduces the competition between small grain and legume seedlings for moisture and provides a better opportunity for legume seedlings to develop a deep root system before summer drought occurs.[3] Net *grain yields* (crop harvested less seed planted) *are not seriously reduced* by the wider spacing of drill rows under average conditions. The smaller number of plants per square foot in wide rows is offset by increased tillering and more vigorous plants with large heads. *A thin stand of sweet clover will add ap-*

[1] Experiments and field observations indicate that successful growth of legume crops on upland soil west of the 99th meridian in Oklahoma will be restricted to seasons or above average rainfall and to soils of medium or fine texture. Climatic hazards decrease east of this meridian, with only occasional seasons being unfavorable for sweet clover production on non-acid fertile soils. (The 99th meridian runs approximately through the center of Dewey, Custer, and Washita counties.)

[2] Legume seedlings grow slowly and have a shallow root system as a result of competition for soil moisture; consequently, they cannot obtain sufficient water from the subsurface soil to survive when rainfall is limited at the time small grain is approaching maturity and drought continues for two or three weeks after harvest.

[3] When small grain is planted in 14-inch rows legume seedlings grow more rapidly in early spring and develop a deeper root system because of reduced competition for moisture and sunlight; consequently, they are in a better position to survive normal summer drought periods than smaller plants which have a shallower root system and cannot obtain moisture from the subsurface soil. Since the area occupied by the small grain will be relatively free from competing vegetation after the small grain is mature, soil moisture accumulating in this area as a result of summer rainfall can be utilized by the lateral root growth of legume seedlings which survive between the rows of small grain.

proximately as much nitrogen and organic matter to the soil as a thicker stand because larger plants develop in the absence of competition.

The income obtained from a nurse crop will usually pay for the limestone and phosphate fertilizer needed to provide a favorable condition for the growth of sweet clover on acid, phosphate-deficient soil containing a good supply of organic matter.[4] On soils having an adequate supply of available mineral nutrients, but low in organic matter and nitrogen, a legume cropping system will increase small grain yields after the first rotation.

No improvement in the stand of legume seedlings will be secured from wide row spacing of a small grain nurse crop when summer rainfall is abundant and summer temperatures are below average. *But when summer drought is severe a good stand of sweet clover can be obtained by this method under many conditions, where a complete failure is likely to result when the grain rows are spaced the usual distance apart.* Wide row spacing has less influence on lespedeza than on sweet clover because the lespedeza has a shallower root system and growth is determined to a very great extent by the presence of available moisture in the surface soil. If sweet clover survives the first summer, it will develop a deep tap root and store sufficient nutrients in the root system during the fall months to make a vigorous growth the second year before hot weather appears. Heavy grazing during the summer or close clipping to control weeds, will prevent or reduce the storage of nutrients in the roots during the fall months, which will decrease the yield the following year. Grazing first-year sweet clover during late fall and winter will not have any appreciable effect on top growth the following spring.

The wide-row method of planting a nurse crop conforms to Nature's way of adapting plants to areas of limited rainfall. For example, grasses change from sod-forming types to bunch types as the availability of soil moisture decreases. It is logical to assume that Corn Belt methods of planting a legume like sweet clover with a nurse crop drilled in rows 7 inches apart should be modified to develop a successful legume rotation system in a subhumid region.

[4] A method establishing sweet clover on such soil at minimum cost by planting the clover in wide rows and applying limestone and phosphate only in the row is described in Oklahoma Experiment Station Circular C-94, "Sweet Clover for Soil Improvement" (May, 1941), and the tests on which that method of fertilization is based are reported in Oklahoma Experiment Station Bulletin B-248 (May, 1941).

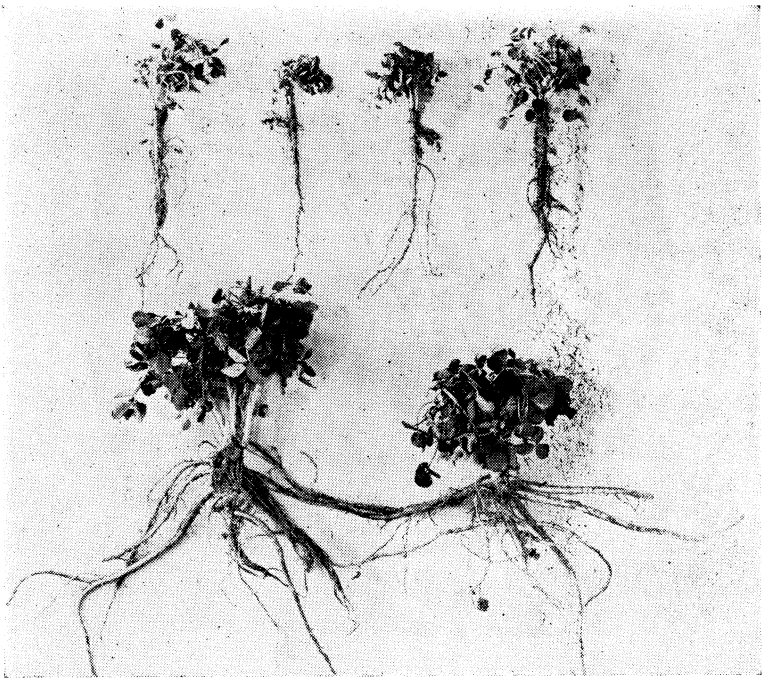

Figure 1.—Sweet Clover planted in seven inch rows or in thick stands produces a tap root with few laterals as shown in upper part of picture. Sweet clover plants spaced farther apart develop many lateral roots if competition from other vegetation is not too severe as shown by two plants in lower part of picture.

SUGGESTIONS FOR USING WIDE-ROW NURSE CROPS

Time and Method of Planting.—Time of planting the small grain is not changed when the wide-row system is used. The sweet clover should be drilled at right angles to the small grain rows during the latter part of February or early in March, with the discs set to cut about one-half inch deep. If a rotary hoe is available, it can be run over the field to develop a large number of shallow holes into which some of the legume seed will fall as they are broadcast over the area.

A firm seedbed is important in getting a stand of lespedeza or sweet clover. When land is plowed a short time before spring oats are planted, a drill equipped with press wheels or a roller should be used to pack the soil. This provides a more favorable condition for the early growth of the legume seedlings. On a loose seedbed, germination is delayed if rainfall

is scanty, or the seed may be covered too deeply if rains are unusually heavy. Reseeding is usually advisable in the latter case.

Rate of Planting.—In the experimental studies reported in this bulletin, the small grain in 14-inch rows was planted at half the rate for 7-inch rows. The rate in 7-inch rows was 2.5 bushels per acre for oats, 2.0 bushels for barley, and 1.25 bushels for wheat and rye.

In eastern Oklahoma and on poor soils, spring oats should be planted at the rate of 1.5 bushels per acre in 14-inch rows by setting the drill at a 3.0 bushel rate and covering every other opening in the drill box. This allows for limited tillering which normally occurs on poor soil and may occur on good soils as a result of excessive rainfall.

Use of Other Row Widths.—In a region where rainfall is low, or when a tall-growing variety of small grain is planted, the 14-inch spacing may be too close to allow the legume seedlings enough moisture and sunlight to develop large plants that can survive summer drought. Under those conditions,

Figure 2.—Planting sweet clover in rows 36 to 42 inches apart and drilling a small quantity of limestone and phosphate fertilizer in the row on acid, phosphorus deficient soil is an effective method of increasing the organic matter and nitrogen content of eroded land.

better legume stands will be obtained by planting two or three rows of small grain the usual distance apart and closing two adjacent holes in the drill to provide a wider space for growth of tre legume seedlings. Tests to date (See page 12) indicate this spacing may reduce grain yields somewhat more than the alternate row spacing, but the loss should not be serious when balanced against the increase in production which will eventually occur from the use of a legume rotation system on nitrogen deficient soils.

The wider spacing of the sweet clover plants will not seriously reduce forage production the second season in drier areas, according to tests conducted at Lawton, Woodward, and Stillwater.

The effect of shading by tall-growing varieties of grain can be corrected to some extent by planting the grain rows north and south on land where contour drilling is not essential for moisture conservation.

Control of Wind Erosion.—On sandy soil where wind erosion is a problem, wide-row spacing of small grain should be used in conjunction with a tillage method which will leave sufficient crop residue on the surface to control the movement of sand in late winter and early spring when wind velocities are high, and the wheat plants are too small to provide a protective cover.

EXPERIMENTAL RESULTS

Five groups of tests comparing a wide-row spacing of small grain nurse crops for sweet clover and/or lespedeza with standard drill spacings of 7 or 8 inches have been made during the past 16 years as follows:

1. With winter wheat, at nine locations in six counties from 1930 to 1944.
2. With spring oats, at 47 locations in 14 counties, from 1936 to 1938. These tests were conducted in cooperation with farmers, with aid in planting and harvesting the plots being given by Soil Conservation Service technicians in 1937 and 1938.
3. With spring oats, at Stillwater, from 1936 to 1945.
4. With winter barley, at Perkins, from 1937 to 1945.
5. With winter wheat, barley and rye, and spring oats, at Perkins, from 1943 to 1945.

EFFECT ON GRAIN YIELD

Winter Wheat

Preliminary tests with wide-row spacing of nurse crops were started in 1930 with winter wheat. The results of nine comparisons are given in Table I. The yields in 14-inch rows were usually only one or two bushels less than in 7-inch rows.

In the Custer County test, planted the first year after sweet clover, the wide row spacing produced more wheat than the narrow spacing. The large quantity of available nitrogen in the soil stimulated plant development to such an extent that the narrow-row plots had more plants than the available moisture could support.

At Perkins, the three-year average yield (Table VI) is only two-tenths bushels per acre higher from plots planted in 7-inch rows. This gives the wide rows a net advantage of approximately four-tenths bushel per acre after seed is deducted.

Spring Oats

Cooperative Tests.—Results of the cooperative tests in 1937 and 1938 are given in Tables II and III.

In 1937, the 14-inch spacing outyielded the 7-inch spacing in 10 of the 36 tests. The average yield for the 36 tests (Appendix Table I) was 25.6 bushels per acre in the 7-inch rows and 23.3 in the 14-inch rows. Only half as much seed was used in the wider rows, so the net loss of yield due to planting in the wider row was approximately one bushel per acre.

In 1938, with unfavorable weather for oats, the 14-inch spacing outyielded the 7-inch spacings in 7 of the 18 tests (Appendix Table II). The average for all tests was 15.6 bushels in

TABLE I.—A comparison of 7- and 14-inch spacing of drill rows on the yield of winter wheat.

County	No. of comparisons	Average yield, bu. per acre	
		7″ rows	14″ rows
Garfield	2	13.5	12.4
Payne	2*	19.4	17.8
Rogers	2	19.7	18.3
Osage	1	9.3	7.3
Custer	1**	9.7	14.1
Blaine	1**	19.5	19.4

* One series of plots not adjacent.
** First year following sweet clover. Custer county test was an 8″ and 16″ comparison.

TABLE II.—A comparison of 7- and 14-inch spacing of drill rows on the yield of spring oats in cooperative experiments with Oklahoma farmers in 1937.

No.	County	No. of tests	Average yield per acre			
			Bu. of grain		Lbs. of straw	
			7″ rows	14″ rows	7″ rows	14″ rows
1	Carter	1	23.7	20.0	1030	830
2	Garfield	2	22.4	20.6	1905	1020
3	Garvin	3	45.7	37.9	1355	1125
4	Grady	6	20.1	25.2		
5	Haskell	7	18.1	20.8	920	960
6	Lincoln	2	7.8	7.3	440	410
7	Mayes	1	34.7	25.5	1470	960
8	Okfuskee	5	35.0	25.7	1475	1075
9	Stephens	8	28.1	22.6	1415	1090
10	Tulsa	1	18.4	16.4	1070	710

TABLE III.—A comparison of 7- and 14-inch spacing of drill rows on the yield of spring oats in cooperative experiments with Oklahoma farmers in 1938.

No.	County	No. of tests	Average yield per acre			
			Bu. of grain		Lbs. of straw	
			7″ rows	14″ rows	7″ rows	14″ rows
1	Grady	4	9.3	6.3	1410	1220
2	McClain	2	15.9	13.4	995	1385
3	Okmulgee	2	16.9	13.7	1600	1375
4	Seminole	2	40.0	30.4	1975	1385
5	Stephens	8	12.3	15.3	1170	1410

the 7-inch rows and 14.6 in the 14-inch rows so the greater yield in the 7-inch rows just about balanced the additional seed used.

In two cooperative tests with farmers in 1936, the average yield of oats was 30.5 bushels per acre in 7-inch rows and 29.8 in 14-inch rows.

Stillwater Experiment.—The net yield from 14-inch rows has averaged 1.5 bushels more than from 7-inch rows over a 10-year period at Stillwater (Table IV). The wider rows actually outyielded the narrower ones in only four years, but the greatest advantage in favor of the 7-inch spacing in any one year was only 1.4 bushels (in 1936). This advantage was only about five pounds greater than the difference in the amount of seed used. The benficial effect of annual sweet clover and Korean lespedeza may have been responsible for the slightly

TABLE IV.—Effect of row spacing on the yield of oats; Stillwater 1936-1945.

Distance Between Rows	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	Yield* Bus. per Acre
Grain in bushels per acre											
7 inches	42.1	20.0	50.8	24.7	50.1	27.0	31.1	27.4	37.6	32.2	34.3
14 inches	40.7	25.3	49.8	25.9	50.6	26.4	32.1	26.6	36.7	31.7	34.6
7 and 21 inches	34.3	23.0	41.0	21.6	42.4	20.3	27.8	25.0	34.7	28.5	29.9
Straw in pounds per acre											
7 inches	1043	718	1675	795	1583	1410	1079	1299	1197	1367	1217
14 inches	974	673	1928	846	1696	1739	1180	1519	1336	1476	1337
7 and 21 inches	859	656	1831	732	1380	1424	955	1197	1128	1249	1141

* Average of 12 replications.

*TABLE V.—Effect of 7- and 14-inch row spacing on yield of winter barley, Perkins, 1937-1945.**

Year	Average Yield, bushels per acre**	
	7″ rows	14″ rows
1937	30.7	23.4
1938	39.3	35.8
1939	39.8	45.2
1940	33.1	17.4***
1941	11.3	12.4
1942	38.4	31.6
1943	3.5	4.8
1944	35.8	25.2
1945	30.7	32.3
Average, all years	29.2	25.3
Average, omitting 1940	28.7	26.3

* During the first three years of this experiment, the wide and narrow row spacing had the same effect from a residual cropping system. During the last six years yields of winter barley in 7-inch rows were obtained on land where sweet clover had been grown two years previously, whereas the yields from the 14-inch row spacing were secured the following year on the same area, which was the third year following sweet clover.

** Adjacent series of 20 or 21 plots receiving the same fertilizer treatment.

*** Very poor stand because of low germination of seed. See text and footnote, page 15.

higher yield of oats in the wider rows since more legume residues were returned to the soil on these plots than on plots where the small grain was planted in drill rows 7 inches apart.

Oat production on plots in which two rows of small grain were planted and two openings in the drill closed[5] to provide a wider space for the growth of the legume seedlings has averaged about five bushels less per acre than plots in which the distance between small grain rows was 14 inches.

Perkins Experiment.—For the past three years at Perkins, yields of spring oats have averaged 21.7 bushels per acre in 7-inch rows and 20.2 in 14-inch rows (Table VI). Deducting seed, the advantage of the narrower spacing is only one-fourth bushel.

Planting three rows of oats and closing two openings in the drill has produced the same average yield of oats as planting in alternate rows 14 inches apart.

Winter Barley

In one of the two tests at Perkins, winter barley has a nine-year average yield of 29.2 bushels per acre in 7-inch rows and 25.3 in 14-inch rows (Table V). This includes one year (1940) when seed treatment to control loose smut seriously reduced

[5] The 7- and 21-inch spacing in Table IV.

Figure 3.—Large sweet clover plants developed between wheat drilled in rows 14 inches apart before the grain was harvested (left). A few small plants can be observed between the 7-inch rows of stubble (right).

TABLE VI.—Effect of row spacing on yields of fall planted wheat barley and rye, and spring oats; Perkins, 1943-1945.

Crop	Row spacing in inches	No. of plots compared	Average 1943	Yield in bu. per A. 1944	1945	Average 1943-45
Wheat	7	10	12.1	13.3	16.4	13.9
	14	10	11.6	14.3	15.1	13.7
Barley	7	4	3.7	22.2	35.1	20.3
	14	4	5.1	17.1	30.1	17.4
Rye	7	4	8.2	10.7	16.5	11.8
	14	4	10.6	11.5	14.8	12.3
Oats	7	12	24.7	19.7	21.5	21.7
	14	12	20.5	22.8	20.8	21.3
Oats	7	6	24.7	19.7	21.5	21.7
	14	6	20.5	22.8	20.8	20.2
	14 and 21*	6	20.0	19.9	20.7	20.3

* Three rows of oats planted and two openings in the drill covered to provide a wider space for the development of sweet clover seedlings.

the stand and yield on the wide-row plots.[6] Omitting 1940, the net advantage is 1.4 bushels per acre in favor of the 7-inch spacing.

In another test at Perkins, during the past three years, 7-inch rows have averaged 20.3 and the 14-inch rows, 17.4 bushels per acre. Net yields, deducting seed, have been 18.3 and 16.4 bushels, respectively, a reduction in yield of 1.9 bushels from the wider spacing. In view of the fact that barley is such an excellent nurse crop for sweet clover, this loss is not serious when it means the difference between a good and a poor stand of sweet clover.

Rye

Rye yields were slightly higher in the 14-inch row plots for two of the three years that this grain has been tested as a legume nurse crop at Perkins (Table VI). Rye is a poor nurse crop for sweet clover and lespedeza, especially in sandy land, because it has a very extensive root system which is well established under average conditions before the legume seed is planted.

Effect on Legume Stand and Yield

In the preliminary tests with winter wheat started in 1930, good stands of sweet clover were secured in several tests when wheat was planted in 14- or 16-inch rows, whereas very poor stands or complete failures occurred where the wheat was drilled 7 or 8 inches apart.

[6] A sufficient number of plants occurred in the 7-inch spacings so that increased tillering could compensate for the reduced stand, and a good crop was produced. The smaller number of plants in the 14-inch spacings was not sufficient to utilize the fertility available in the soil.

In the test at Stillwater (Table IV), very little difference has been observed in stands of either lespedeza or annual sweet clover in years when summer rainfall was favorable. During dry seasons the superior height and density of legume cover on the wide-row plots has been easily seen. In 1943, dry forage yield were as follows:

	Annual Sweet Clover	Lespedeza
Oats in 7-inch rows	320 lb. per acre	990 lb. per acre
Oats in 14-inch rows	640 lb. per acre	1,400 lb. per acre

In the nine-year test with winter barley planted in 14-inch rows at Perkins, the sweet clover is drilled at right angles to the barley rows early in March each year. An excellent stand of sweet clover has been obtained on all plots where soil acidity or a nutrient deficiency has not limited its growth.

A test started on the Perkins Farm in 1943 to obtain more accurate information on the yield of lespedeza and sweet clover on plots where wheat, oats, barley and rye are planted in 7-

Figure 4.—Planting three rows of small grain and closing two openings in the drill box will provide a more favorable condition for survival of the sweet clover seedlings during severe summer drought periods.

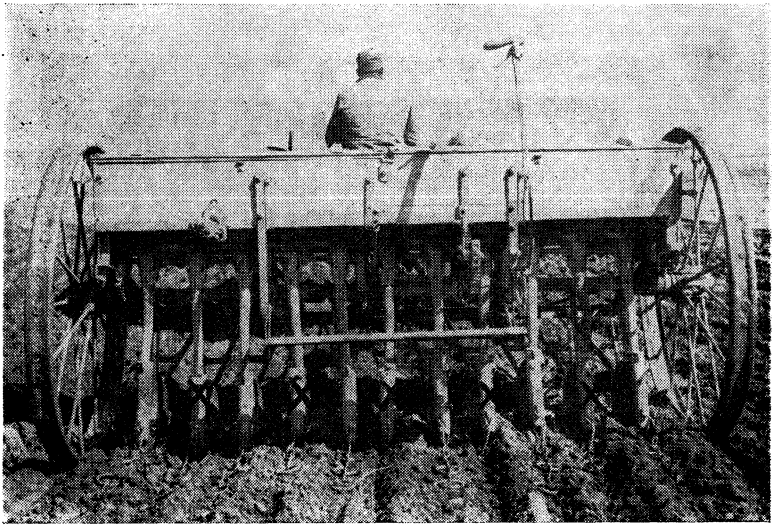

Figure 5.—Alternate rows of small grain can be planted by closing every other opening in the drill as x's indicate in the above picture. This spacing is recommended for eastern Oklahoma.

and 14-inch rows has given very little information since rainfall during the past three years has been very favorable for the survival of legume seedlings when the nurse crops were planted in 7-inch rows. No pronounced differences in forage yield have been secured. Korean lespedeza yields in pounds per acre have been as follows:

	Grain in 7-inch rows	Grain in 14-inch rows
1943	1,330 lb. per acre	1,420 lb. per acre
1944	4,730 lb. per acre	4,750 lb. per acre
1945	4,840 lb. per acre	5,120 lb. per acre

Korean lespedeza under average rainfall conditions in this area usually produces considerably less than one thousand pounds of dry forage per acre during the summer and fall months when planted in small grain.

Experiments at Lawton and Woodward[7] indicate that young sweet clover plants in 7-inch rows compete with each other for soil moisture to such an extent that they are frequently killed by hot, dry weather in July and August. Re-

[7] On medium-textured soils with slowly permeable subsoils at Lawton; and on coarse-textured soils with permeable subsoils at Woodward, Oklahoma.

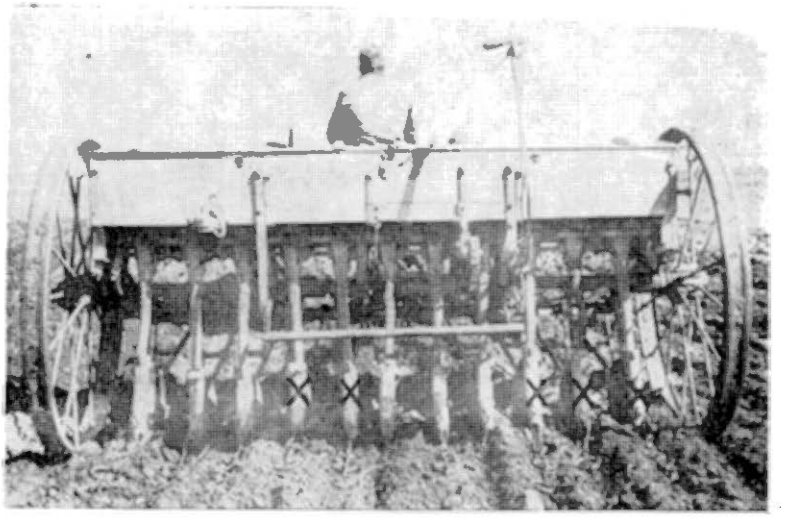

Figure 6.—To obtain three rows of grain and two sweet clover spaces, let No. 1 disk follow in the No. 11 track, if using an 11-hole drill. Drive one row wider with a 14-hole drill.

ducing the number of plants per unit area by spacing the rows 36 to 42 inches apart has increased survival when competition from other vegetation is controlled by cultivation. The ability of a thin stand of sweet clover to produce large plants in the absence of competition can explain why a method of planting which will insure a thin stand may be of as much benefit to the soil as a procedure which will produce a larger number of plants per unit area.[8] Root yields of sweet clover planted in 7-inch rows at the Perkins farm and harvested in April the following year were 875 pounds per acre (oven-dry weight) as compared with 905 pounds produced by the same variety of clover planted in rows 42 inches apart. Figure 1 shows the vertical growth of sweet clover roots when plants are closely spaced as compared with the lateral branching which develops when plants are farther apart and competition from other vegetation is not too severe.

[8] The effect of distance between drill rows on the survival of Evergreen sweet clover (a late maturing white biennial type) is being studied in several four-year rotations with winter wheat and spring oats, in connection with the test started at Perkins in 1943. This variety planted in 42-inch rows has produced about the same yield of forage as was obtained from a plot planted in 14-inch rows.

SUMMARY

The effect of planting a small grain nurse crop in rows seven or fourteen inches apart on the growth of legume seedlings and yield of grain has been studied at the Oklahoma Agricultural Experiment Station over a period of sixten years. Increasing the distance between rows of small grain from seven or eight inches to fourteen or sixteen inches by closing every other opening in the grain drill will provide a more favorable opportunity for the survival of legume seedlings during normal drought periods.

Results of cooperative tests in central and eastern Oklahoma show that the effect of row spacings on yield were quite variable. The average production of grain and straw was slightly lower when drill rows were fourteen inches apart and only one-half as much seed was planted as compared with a seven-inch spacing.

Spring oats planted over a ten-year period at Stillwater, Oklahoma have produced as much grain when drilled in fourteen-inch rows as when planted in seven-inch rows. The average yields were 34.6 and 34.3 bushels, respectively. Michigan winter barley, planted in fourteen-inch rows at the rate of one bushel per acre, has suffered a slightly greater reduction in yield, about two bushels net loss, than winter wheat, rye, or spring oats.

Very little advantage in the stand of legume seedlings will be secured from wide-row spacing of small grain when summer rainfall is abundant and summer temperatures are below average. During many seasons when summer drought is severe, a good stand of sweet clover will be obtained on plots when the small grain is drilled in 14-inch rows whereas complete failure will occur on plots where the drill rows are spaced 7 inches apart.

Wide-row spacing should also be practiced the first year after sweet clover or alfalfa land has been plowed and planted to wheat to reduce the "burning effect" which frequently occurs as a result of increased vegetative growth and insufficient soil moisture to mature the crop.

APPENDIX:
COOPERATIVE TEST RESULTS, BY COUNTIES

*APPENDIX TABLE I.—Comparative effect of 7- and 14-inch spacing of drill rows on the yield of spring oats, 1937 Cooperative Experiments.**

No.	County	Yield of Grain (bushels per acre)		Yield of Straw (pounds per acre)	
		7″ rows	14″ rows	7″ rows	14″ rows
1	Carter	23.7	20.0	1030	830
2	Garfield	32.1	29.3	1280	990
3	Garfield	12.7	11.9	2530	1150
4	Garvin	51.5	34.9	1160	840
5	Garvin	53.9	49.1	1590	1470
6	Garvin	31.7	29.7	1320	1070
7	Grady	26.7	34.6		
8	Grady	33.5	36.1		
9	Grady	13.9	12.7		
10	Grady	15.7	26.1		
11	Grady	12.4	18.7		
12	Grady	18.6	22.9		
13	Haskell	16.3	11.6	650	530
14	Haskell	25.7	11.2	1350	650
15	Haskell	11.3	19.9	570	940
16	Haskell	47.0	66.4	1630	2130
17	Haskell	5.5	9.6	400	560
18	Haskell	13.4	7.6	1270	670
19	Haskell	7.6	19.1	550	1240
20	Lincoln	8.1	5.7	330	270
21	Lincoln	7.6	9.0	550	550
22	Mayes	34.7	25.5	1470	960
23	Okfuskee	48.1	33.1	2260	1470
24	Okfuskee	36.5	25.3	1490	970
25	Okfuskee	38.3	26.7	1390	1140
26	Okfuskee	24.8	19.7	815	670
27	Okfuskee	27.6	23.7	1420	1120
28	Stephens	31.3	24.2	1270	1170
29	Stephens	13.9	8.9	730	560
30	Stephens	45.1	39.8	2150	1630
31	Stephens	30.6	27.2	2020	1590
32	Stephens	23.6	18.0	1590	1030
33	Stephens	13.2	9.8	820	650
34	Stephens	26.9	22.4	910	645
35	Stephens	40.3	30.6	1840	1450
36	Tulsa	18.4	16.4	1070	710
	Averages	25.6	23.3	1249	989

* All comparisons were planted in quadruplicate. An area equivalent to 10 rod rows spaced 7 inches apart was harvested from each plot and acre yields of grain and straw calculated from these samples.

APPENDIX TABLE II.—A comparison of 7- and 14-inch spacing of drill rows on the yield of spring oats obtained in cooperative experiments on Oklahoma farms in 1938.*

No. of test	County	Yield of Grain (bushels per acre)		Yield of Straw (pounds per acre)	
		7″ rows	14″ rows	7″ rows	14″ rows
1	Grady	7.4	6.7	1050	960
2	Grady	10.7	6.6	1130	770
3	Grady	10.3	6.5	1210	890
4	Grady	9.0	5.6	2240	2270
5	McClain	11.9	11.6	810	1770
6	McClain	20.0	15.2	1180	1000
7	Okmulgee	10.7	7.3	1050	770
8	Okmulgee	23.2	20.2	2150	1980
9	Seminole	37.6	25.2	2240	1520
10	Seminole	42.3	35.6	1715	1250
11	Stephens	8.1	11.6	1020	1520
12	Stephens	11.3	15.0	1280	1240
13	Stephens	5.2	7.7	1120	1150
14	Stephens	27.1	30.9	1620	1970
15	Stephens	2.2	2.7	990	1000
16	Stephens	9.9	13.8	860	1180
17	Stephens	20.2	17.8	1450	1860
18	Stephens	14.2	23.4	1110	1330
Averages		15.6	14.6	1346	1357

* All comparisons were planted in quadruplicate. An area equivalent to 10 rods rows spaced 7 inches apart was harvested from each plot and acre yields of grain and straw calculated from these samples.

9/46—9M