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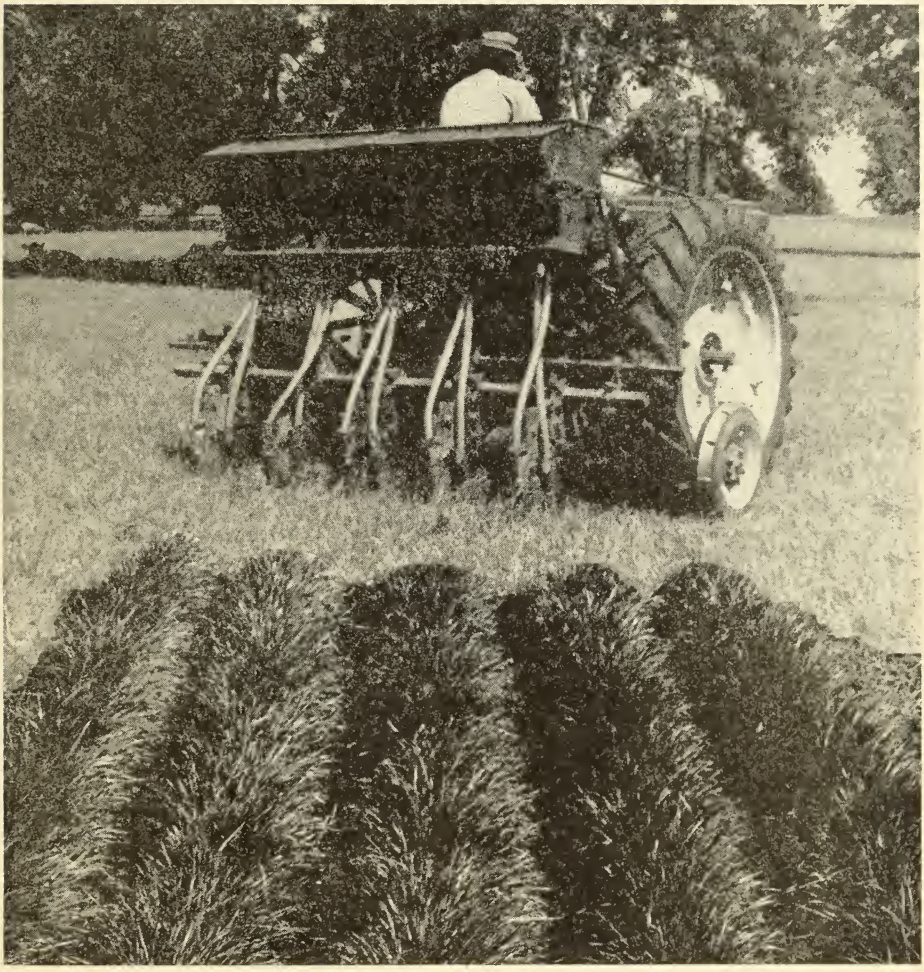

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SEEDING IN PERMANENT PASTURE FOR SUPPLEMENTARY WINTER GRAZING

By RICHARD F. DUDLEY and LOUIS N. WISE[1]

Introduction

The conventional method of seeding supplementary winter grazing crops, such as oats, wheat and ryegrass, requires extensive land preparation resulting in high labor and equipment cost. On heavy wet soil types, complete seedbed preparation often results in excessive bogging of animals and trampling of the forage during the winter grazing period.

Under average Mississippi conditions three acres of pasture are required to adequately support one animal unit. A method of seeding a supplementary winter grazing crop in a summer permanent pasture sod, with no appreciable damage to the pasture, should provide two grazing seasons on the same area and significantly reduce the acreage requirement per animal unit.

Materials and Methods

The Agricultural Engineering and Agronomy Departments of the Mississippi Agricultural Experiment Station began a study in the fall of 1949 to determine the best cultural methods of seeding and fertilizing winter grazing crops in summer permanent pasture sods for supplementary winter grazing.

To seed and fertilize a supplementary crop in a permanent pasture sod with minimum damage to the pasture, it was necessary to develop special equipment. Several types of sod openers were tested, and it was found that a thin opener (1" thick) sharpened to a knife edge with a suction point attached on the bottom gave good results in all types of soil encountered. The cutting edge sliced through the sod and produced very little disturbance to the sod. These openers were mounted on a friction safety device which was attached to the tractor toolbar bedder. A safety trip was found to be very desirable when operating in pastures where stumps, roots and rocks might be encountered. Above the toolbar, a seed and fertilizer box was mounted rigid to the tractor axle housing. The seed and fertilizer were carried to the openers through flexible tubes. The toolbar and openers were raised hydraulically by the lift arms of the tractor and the driving mechanism automatically disengaged or engaged as the toolbar was raised or lowered. The drive was directly connected to the tractor axle. To allow separation of the seed and fertilizer a second opener was mounted behind and about an inch to the side of the first opener. The second opener, mounted an inch higher than the first opener, placed the seed an inch to the side and one inch above the fertilizer. The depth was controlled by the depth gauge wheels located on each end of the toolbar.

In the fall of 1949, test plots were established at the Brown Loam, Black Belt, Coastal Plain and Northeast Mississippi Experiment Stations (located at Oakley, Brooksville, Newton and Verona, respectively). At each location the following treatments were applied to a permanent pasture sod consisting of Dallisgrass, Bermuda-grass, and white clover:

1. Oats and fertilizer drilled in the sod at 8" intervals.

2. Oats and fertilizer drilled in the sod at 16" intervals.

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Conducted in cooperation with Robert C. Albritton, Superintendent, Northeast Mississippi Branch Experiment Station; Robert E. Coates, Assistant Agronomist, Brown Loam Branch Experiment Station; Kelley C. Freeman, Assistant Agronomist, Coastal Plain Branch Experiment Station; Louie B. Walton, Superintendent, Black Belt Branch Experiment Station.

Robert E. Coates, Assistant Agronomist, Brown Loam Branch Experiment Station, will use the data reported in this paper for the preparation of a thesis to be submitted in partial fulfillment of the requirements of an M.S. degree.

Figure 1. Experimental equipment developed to study the principles of seeding and fertilizing supplementary winter growing crops in a permanent pasture sod. Note arrangement for obtaining fertilizer placement variable.

3. Oats seeded and fertilizer applied to the sod with grain drill; disced.

4. Sod disced; oat seed and fertilizer applied with grain drill.

5. Conventional or complete seedbed preparation. Oats seeded and fertilizer applied with grain drill.

6. Ryegrass seeded and fertilizer applied with grain drill on undisturbed sod.

7. Oats seeded and fertilizer applied with grain drill to undisturbed sod.

8. Check—fertilizer applied to sod, no seedbed preparation and no seeding.

Oats and fertilizer were drilled into the sod in one operation at both 8" and 16" spacings. In the conventional plots, a good seedbed was prepared by discing four or five times, and the oats and fertilizer were sown with a regular grain drill. Oats were seeded at the rate of

Table 1. Influence of methods of seeding oats in permanent pasture sod as measured by yield per acre of dry forage. Seed and fertilizer separated. (1949-50; four locations).

Treatments—Methods of seeding	Brown Loam	Black Belt	Coastal Plains	North-east Miss.	Average 4 locations
Drilled at 8" intervals	3204	4745	2059	2123	3032
Drilled at 16" intervals	3018	4224	1634	1943	2779
Disced and seeded	2274	3009	1571	2115	2242
Seeded and disced	2542	3268	1480	1519	2202
Conventional seedbed preparation	2752	3280	1796	2093	2480
Ryegrass seeded on top	1911	2641	1667	1246	1866
Oats seeded on top of sod	1693	3089	1578	1432	1948
Check	1862	1037	1183	1059	1285
LSD (.05)	442	669	497	552	
LSD (.01)	592	898	667	740	

four bushels per acre and fertilizer applied at the rate of 60 pounds of nitrogen from sulfate of ammonia, 60 pounds of P_2O_5 from superphosphate, and 50 pounds of K_2O from muriate of potash per acre on all plots including the check plot. All tests were arranged in a randomized complete block design with six replications.

Results and Discussion

1949-1950

Three clippings were made at each of the four locations during the 1949-50 season. Results are summarized in Table 1.

At all locations, the highest yielding treatment was oats drilled into the sod at 8" intervals. The 16" spacing gave only slightly lower yields and both were generally superior to plots seeded in the conventional manner.

Early growth of supplemental pasture is very important in a winter grazing program. The practice of drilling seed and fertilizer into the sod resulted in considerably more fall and winter production than did the conventional method. (Table 2.)

A single clipping was made during the following summer (July, 1950) to determine the effect of the oats and method of seeding on the subsequent production of the permanent pasture sod to which the treatment has been applied. (Table 3.)

Highest summer yields were generally obtained from the undisturbed, unseeded check plots. Production was generally higher on the plots on which oats had been seeded the previous fall in 16" spacings than in the narrower 8" drills. Summer yields were higher on both the 8" and 16" plots than where oats had been seeded on a conventional seedbed. In general, summer production of the permanent pasture was reduced in proportion to the degree to which the sod had been disturbed the previous fall.

1950-1951

The investigation was continued in the fall of 1950. Incorporated in the 1950-51 test was an additional factor involving fertlizer placement. On half of each of the 8" and 16" spaced plots, seed (oats) and fertilizer were separated in the drill (as in 1949-50), the fertilizer being placed approximately one inch below and slightly to the side of the seed. On the

Table 2. Seasonal distribution of oat forage production as influenced by method of seeding. Avevarge of four locations (1949-50).

Treatments—Method of seeding	Yield in lbs. per A of dry forage			
	1st clipping (January)	2nd clipping (March)	3rd clipping (May)	Total
8" spacing	532	645	1855	3062
16" spacing	438	601	1741	2780
Conventional	149	411	1920	2480
Ryegrass on top	0	44	1822	1866
Check	0	0	1285	1285

Table 3. Influence of method of seeding oats in a permanent pasture on the yield of the permanent pasture duriing the subsequent season. Four locations; summer 1950.

Treatments—Methods of seeding	Yield of permanent pasture in lbs. per A of dry forage				
	Brown Loam	Coastal Plain	Black Belt	Northeast Miss.	Average
8" spacing	2621	1405	1090	1584	1675
16" spacing	2961	1303	1526	1591	1846
Conventional seedbed	2379	971	895	802	1278
Check (undisturbed)	2867	1221	1428	2669	2046
LSD (.05)	466	241	225	598	
LSD (.01)	626	324	302	803	

other half of these plots, seed and fertilizer were applied together in the drill (mixed). The rate and type of fertilizer materials used was the same as described for the 1949-50 test.

Oats seeded in the sod at 8" and 16" intervals consistently produced more forage than those seeded on a prepared seedbed. At two of the three locations reported, production was higher on the 16" treatments than on those seeded at the closer spacing. (Table 4.)

At all locations except the Black Belt, mixing of the seed and fertilizer in the drill resulted in lower and slower rates of germination, in poorer growth of the seedlings, and lower initial production of forage. As indicated in Table 5, damage to the seeds or seedlings due to direct contact with the fertlilizer in the drill was generally more pronounced on the 16" than on the 8" spacings. Since the per acre rate of application of seed and fertilizer is constant for all treatments, the concentration of fertilizer per unit area was higher in the 16" drills and more damage to the oats would be expected.

Because of erratic stands, no results are reported from the Black Belt Branch Experiment Station. Visual observation of the initial growth at this location and of several large field seedings not included in the tests being reported, indicated variable response to fertilizer placement. Mixing of seed and fertilizer in the drill did not always result in injury to stands or lowered production. Soil moisture appeared to determine the occurrence and extent of damage resulting from this practice. At one moisture level, germination and stand establishment was severely affected by placing the seed in contact with the fertilizer. At another moisture level, even at the same location, no damage occurred.

1951-1952

The study was revised in the fall of

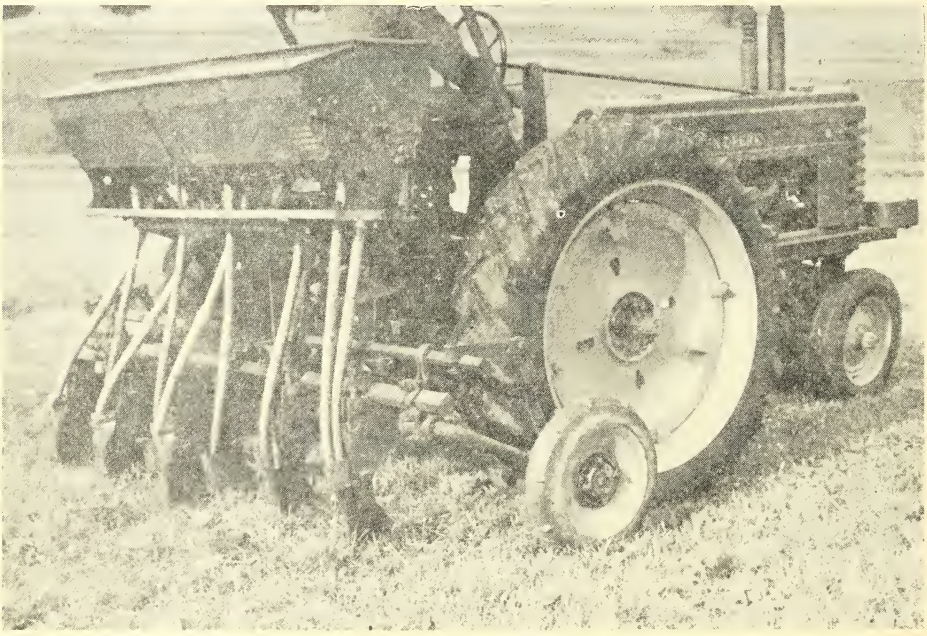

Figure 2. Shows experimental machine operating in a permanent pasture sod. The two openers on the right place the seed and fertilizer together, the three openers on the left separate the seed and fertilizer.

Figure 3. Illustrates the minimum damage suffered by the sod when ryegrass was seeded into a permanent pasture at 16" intervals. Picture taken immediately after seeding operation. (Brown Loam Branch Experiment Station.)

Table 4. Influence of method of seeding oats in permanent pasture sod on the yield per acre of dry oat forage. 1950-51; three locations.

Treatment—Method of seeding	Yield in lbs. per A of dry forage—all clippings*			
	Brown Loam	Coastal Plain	Northeast Miss.	Average of 3 locations
8" spacing	4132	2493	1746	2790
16" spacing	3735	3190	2007	2981
Conventional seedbed	3116	1165**	1288	1856
Check	2071	2036	628	1578

*Number and date of clippings at each location:
Brown Loam—3 clippings—November 10, March 23, and May 5.
Coastal Plain—3 clippings—November 15, April 2, and May 18.
Verona—1 clipping—April 24.
**Represents only 2 clippings; other treatments means at this location include 3 clippings.

Table 5. Effect of fertilizer placement on the yield of oats seeded in the sod at three locations. 1950-51.

Treatments Method of seeding	Seed & fertilizer separated	Seed & fertilizer together	Percent increase due to separation of seed and fertilizer
Northeast Miss.—Only one clipping obtained			
8" spacing	1746	1095	59%
16" spacing	2007	1147	75%
Brown Loam—1st and 2nd clipping			
8" spacing	1984	1312	51%
16" spacing	1756	1206	46%
Coastal Plain—1st and 2nd clipping			
8" spacing	1301	1105	18%
16" spacing	1491	1147	30%

Figure 4. Oats seeded directly in sod with experimental seeder at 8" spacing. The seed and fertilizer was separated . Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

Figure 5. Oats seeded directly in the sod with experimental machine at 16" spacing. The seed and fertilizer was separated. Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

1951 to include, in addition to oats, ryegrass and fescue. The revised test consisted of the following treatments:

1. Oats and fertilizer drilled into the sod at 8" intervals.
2. Oats and fertilizer drilled into the sod at 16" intervals.
3. Conventional or complete seedbed preparation. Oats seeded and fertilizer applied with grain drill.
4. Ryegrass and fertilizer drilled into the sod at 8" intervals.
5. Ryegrass and fertilizer drilled into the sod at 16" intervals.
6. Ryegrass and fertilizer broadcast on the sod.
7. Conventional or complete seedbed preparation. Ryegrass seeded and fertilizer applied with grain drill.
8. Fescue and fertilizer drilled into the sod at 8" intervals.
9. Fescue and fertilizer drilled into the sod at 16" intervals.
10. Conventional or complete seedbed preparation. Fescue seeded and fertilizer applied with grain drill.
11. Check—fertilizer broadcast on sod, no seeding.

The seeding rates for oats, ryegrass and fescue were 120, 20 and 10 pounds per acre, respectively. The rate of fertilizer applied, the materials used, and method of placement was similar to the previous year's tests.

Two clippings were made at each of four locations; and the resulting total yields, disregarding the fertilizer placement variable, are presented in Table 6.

At the Brown Loam Branch Experiment Station, conventionally seeded plots generally outyielded those drilled into the sod at either 8" or 16" intervals. The 16" treatments consistently produced more oat and ryegrass forage than did the 8" treatments. Competition for moisture appeared to be the most important factor governing treatment response. The 1951-52 season was exceptionally dry; complete seedbed preparation more nearly eliminated the competition from the permanent pasture species for the limited moisture supply. Similar results were obtained at Verona.

At the Black Belt and Coastal Plain Stations the relative ranking of the 8" and 16" treatments and of the convention-

Table 6. Influence of methods of seeding oats, ryegrass and fescue in a permanent pasture sod on the yield of dry forage. Seed and fertilizer separated. (1951-52, four locations).

Treatments—Method of seeding	Yield in lbs. per A of dry forage—Average of all clippings*				
	Brown Loam	Black Belt	Coastal Plain	Northeast Miss.	Average of 4 locations
Oats					
8" spacing	4626	6031	6476	4298	5358
16" spacing	5464	5590	5853	4685	**5398**
Conventional	7936	4133	5456	5231	5689
Ryegrass					
8" spacing	4073	4191	7086	4921	5068
16" spacing	4490	5083	5815	7318	5676
Surface broadcast	2780	3678	1036	3574	2767
Conventional	5940	3606	4085	6203	4958
Fescue					
8" spacing	3024	1737	3088	3510	2841
16" spacing	3934	1878	3120	3837	3192
Conventional	2715	627	616	3713	1918
Check	2340	1653	2575	716	1821

*Number and dates of clippings:
Brown Loam: April 11 and May 21, 1952.
Black Belt: April 3 and May 22, 1952.
Coastal Plain: November 13, 1951 and May 5, 1952.
Verona: October 10, 1951 and April 30, 1952.

ally seeded plots were reversed. Inconsistency in treatment response between locations may be the result of: (1) different moisture conditions at the time of seeding or during early growth of the seedlings, (2) differences in density and relative dormancy of the pasture sod on which the tests were located, or (3) other undetermined factors.

Broadcast seeding of ryegrass on an undisturbed sod resulted in practically no fall and winter production and in low total yields.

At the Black Belt Station, placement of fertilizer in contact with the seed generally resulted in poorer stands and reduced yields of oats, ryegrass and fescue. Since the per acre rate of application of seed and fertilizer was constant for all treatments, the concentration of fertilizer in contact with the seed was greater in the 16" drill intervals than at the closer 8" spacings. As indicated in Table 7, when seed and fertilizer were not separated injury to germination and to subsequent production was more pronounced at the wider spacing intervals.

Visual observation at the other three locations during the early part of the growing season, indicated no striking differences in stand or vigor of seedlings due to fertilizer placement.

1952-1953

The 8" treatments were eliminated in the 1952-53 studies; wheat was substituted for oats to reduce the danger of winter killing.

Satisfactory stands of supplementary forages were not obtained at several locations due to lack of moisture in the fall of 1952. Results are reported only for the test at the Brown Loam Branch Experiment Station. (Table 8.)

Slightly more wheat and ryegrass forage was produced at the 1st and 2nd clippings on the conventionally prepared and seeded plots than when these crops were drilled into the pasture sod. Competition for moisture was apparently the governing factor. Because of increased production at the 3rd and 4th clippings

Figure 6. Oats seeded on a prepared seedbed (disced four or five times) with the conventional grain drill. Seeded Sept. 28, 1949 at Verona. Photo Dec. 19, 1949.

Figure 7. Oats seeded and fertilized directly in the sod at 8" spacing with experimental machine. Seeded Sept. 15, 1949 at Brooksville. Photo May 10, 1950.

on the seeded-in-the-sod plots, there was very little difference in total forage production as a result of treatments (methods of seeding). Although the check or unseeded plots produced a considerable quantity of forage, most of this production occurred in the late spring. Production of fescue followed a similar distribution curve, regardless of method of seeding.

There were no measurable differences in yield due to fertilizer placement.

Conclusions and Recommendations

Two years results indicate oats, wheat, ryegrass and other supplementary winter growing forage crops may be successfully seeded (drilled) in a permanent pasture sod without conventional seedbed preparation. Total yields of the supplemental forages seeded in this manner have been equal or superior to those obtained by the conventional method of complete seedbed preparation, and definitely superior to the yields of these crops when

Table 7. Effect of fertilizer placement on the yield of the first clipping of oats, ryegrass and fescue forage at the Black Belt Branch Experiment Station. (April, 1952).

Treatment—Method of seeding	Seed & fertilizer separated	Seed & fertilizer together	Percent increase due to separation of seed and fertilizer
Oats			
8" spacing	3212	3504	—9.0
16" spacing	2643	2306	+13.0
Ryegrass			
8" spacing	3372	2777	+21.0
16" spacing	2454	1873	+31.0
Fescue			
8" spacing	765	626	+22.0
16" spacing	1320	873	+51.0

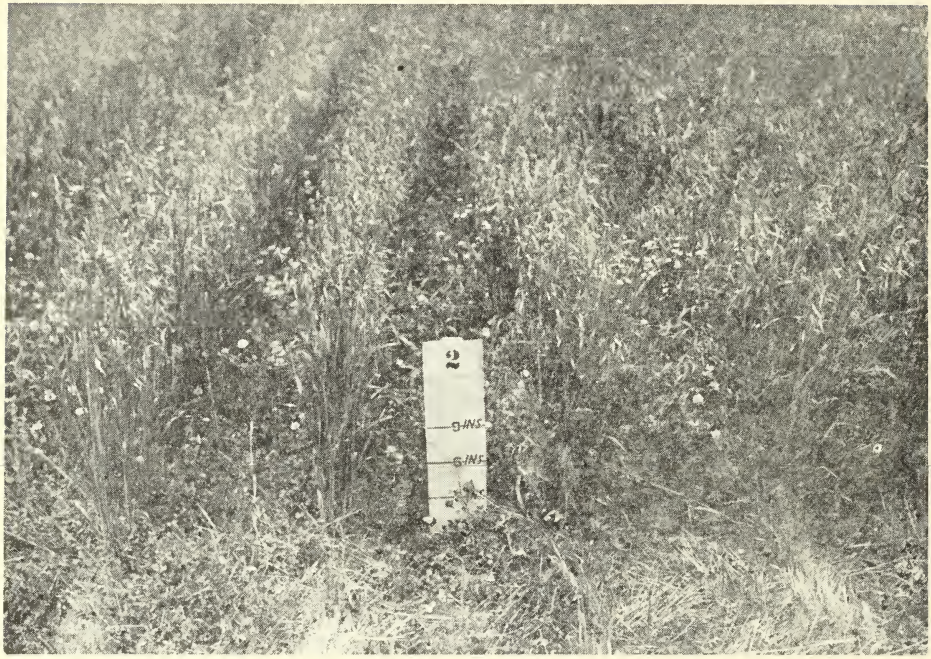

Figure 8. Oats seeded directly in the sod at 16" spacing with experimental machine. Seeded Sept. 15. 1949 at Brooksville. Photo May 10, 1950.

Table 8. Influence of method of seeding and fertilizer placement on the yield of wheat, ryegrass and fescue forage at the Brown Loam Branch Experiment Station (1952-53.)

Treatments— Method of seeding	1st clipping Jan. 29	2nd clipping Feb. 16	3rd clipping April 8	4th clipping May 25	Total
Wheat					
16" spacing, seed & fert. separated	417	690	2838	2346	6291
16" spacing, seed & fert. together	402	623	2529	2580	6134
Conventional seedbed	771	1035	1893	959	4658
Ryegrass					
16" spacing, seed & fert. separated	227	582	2298	3074	6181
16" spacing, seed & fert. together	313	565	2148	2709	5735
Broadcast on sod, no preparation	112	597	2430	3035	6174
Conventional seedbed	357	954	2465	2769	6544
Fescue					
16" spacing, seed & fert. separated	0	0	1844	3209	5053
16" spacing, seed & fert. together	0	0	1810	3485	5295
Conventional seedbed	0	0	1127	3596	4723
Check	0	0	1720	3281	5001

Figure 9. Conventional practice—oats and fertilizer seeded on a prepared seedbed with grain drill. Seeded Sept. 15, 1949 at Brooksville. Photo May 10, 1950.

seeded on the surface with no preparation or with varying degrees and methods of seedbed preparation (discing, etc.).

Damage to the permanent pasture was proportional to the degree the sod had been disturbed during the seeding operation and to the competitiveness of the resulting supplementary forage. The 8" seeding interval generally produced slightly more supplementary forage than the 16" spacing but the latter resulted in less damage to the permanent pasture. An even wider spacing might be used with equal effectiveness.

Competition between the supplementary crop and the permanent pasture may be reduced to a minimum by heavy grazing of the supplementary crop in late spring at the time the permanent pasture species resumes growth.

The supplemental crop (oats, wheat, rye, ryegrass, fescue, etc.) should not be drilled into the sod until the permanent pasture plants have become dormant or practically dormant. Earlier seeding results in competition between the seedling and the established sod for moisture, fertilizer and light. All excess forage must be removed by close grazing or clipping prior to seeding (drilling) the supplementary crop into the sod.

Moisture is the most critical factor influencing the success of sod seedlings. Low moisture levels in the fall reduce the earliness and total yields of the drilled seeding as compared to those seeded on a well prepared and fallowed seedbed.

Small grains should be drilled approximately 2" below the sod; ryegrass, fescue and other small grass or legume seeds should be placed about ½" deep. Although conventional seeding rates were used for all treatments during the course of this experiment, it appears logical that this rate could be reduced one-third to one-half when 16" or wider spacings are used, without reducing the yields.

The amount of fertilizer to be applied

is the same as recommended for the crop when seeded in the conventional manner. Due to the higher rates of fertilization now being recommended, and the proportionately higher concentration of fertilizer in the drill resulting from wider spacing of the drills, seed and fertilizer should be separated. The fertilizer should be placed directly below the seed or as nearly directly below the seed as possible with available equipment. Mixing of the seed and fertilizer (containing salts) in the drill will often result in lower and slower germination and in poorer initial growth of the seedlings.

Seeding of winter grazing annual crops in a permanent pasture sod results in: (1) lower pasture establishment cost, (2) less bogging of animals and trampling of the forage during wet periods, (3) more efficient utilization of land resources, and (4) reduction of soil and water loss.

Machinery and Utilization

The equipment used in the course of this investigation was designed for experimental purposes and has given very satisfactory results in this basic study of seed and fertilizer placement in a pasture sod. It is recognized, however, that there are many modifications which should be made before a machine of this type is placed in production.

The machine should be a quick detachable or trail type. The fertilizer and seed hopper should be located as close as possible to the ground to aid in loading the seed and fertilizer. The fertilizer hopper should have a capacity of approximately 500 pounds and the seed box should carry about 100-120 pounds of small grains which would plant approximately one acre. Cut-a-way rolling coulters would aid in preventing the accumulation of trash in front of the openers if sufficient weight can be obtained to get the desired penetration. Independent action of each opener would give uniform planting depth especially in hilly pasture. The openers should have replaceable points and if possible the seed and fertilizer should be separated within the opener, thereby eliminating the need for a second opener.

Several types of sod-seeding equipment, possessing in various degrees the above described specifications, are now commercially available. Additional models by other farm machinery manufacturers are anticipated.

Such machines should have wide ap- Their value in the seeding of small grains plication in grassland farming practices. and other annual grasses in permanent pasture sods has been adequately demonstated. It is anticipated that the following operations could be accomplished with equal effectiveness.

1. Seeding of legumes such as wild winter peas, red clover, or lespedeza in Johnsongrass, small grains or in any type pasture to which the addition of legumes is desired.

2. Reseeding and fertilization (renovation) of permanent pastures without seedbed preparation and the resulting loss in grazing.

3. Seeding and fertilization of perennial grasses and legumes on very steep, highly erosible areas.

4. Seeding and fertilization of small grains, ryegrass, or perennial grasses in a reseeding legume such as crimson clover, white clover, or lespedeza.

5. Seeding and fertilization of a summer supplementary forage such as millet or Sudangrass on an area seeded the previous season with winter annuals such as crimson clover, small grains, etc. Millet and Sudangrass should not be seeded in a summer pasture sod. The fertilizer applied with the millet or Sudangrass stimulates the perennial species to the exclusion of the crop being seeded.

6. Seeding and fertilization of any pasture species on **prepared seedbeds.** The usefulness of this equipment is not confined to seeding in the sod.

Figure 10. A comparison between ryegrass seeded in the sod with the fertilizer separated from the seed (right side of picture) and ryegrass seeded in the sod with the seed and fertilizer together (left side of picture). Seeded on September 28, 1951. This picture was made at Oakley, Mississippi, March 5, 1952.

Figure 11. A comparison of ryegrass broadcast on top of the sod and fertilized (right side of picture) to ryegrass seeded and fertilized in the sod at 16" spacing (left of picture). Seeded on November 13, 1951. This picture was made at Newton, Mississippi, on March 4, 1952.