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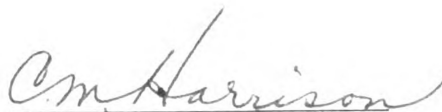
THE EFFECT OF VARIOUS COMPANION  
CROPS ON THE ESTABLISHMENT OF  
ALFALFA SEEDINGS

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THE EFFECT OF VARIOUS COMPANION CROPS ON THE  
ESTABLISHMENT OF ALFALFA SEEDINGS

By

Robert Eugene Briggs

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## INTRODUCTION

In the North Central States the majority of alfalfa seedings are established with a companion crop. Companion or nurse crops provide a return from the land during the seeding year, control the growth of annual weeds, and help prevent wind and water erosion.

The widespread use of various companion crops when making forage seedings poses a question as to which ones are best suited to use when making such seedings. The comparative earliness or lateness of a given variety of small grain may have an affect on the proper establishment of the seeding.

The present experiment was set up to study the effects of various crops and varieties upon the establishment of alfalfa seedings.

## REVIEW OF LITERATURE

The use and value of companion crops has often been questioned. The following review of literature shows the results of seeding forage crops with various companion crops in widely separated areas of the United States.

At the Sandpoint, Idaho' Agricultural Experiment Station(1), various legumes planted with nurse crops in 1925 yielded almost as well as when seeded alone; while in a later year (2) alfalfa sown with oats as a nurse crop gave only a 25 percent stand.

Hawk and Hafenrichter of Washington (3) state that "legumes grown alone are always superior to those grown with a companion crop".

As reported from the Washington Agricultural Experiment Station (4), the use of a nurse crop reduces the chance of getting a stand of alfalfa or red clover.

At the Arkansas Agricultural Experiment Station (5), alfalfa made a stand with spring oats in 1926 but grew poorly.

In an experiment in Arizona, Clark (6) found that the nurse crop hindered the top and root growth of alfalfa.

The Storrs, Connecticut Agricultural Station (7) reported that alfalfa seeded in oats in 1926 gave good stands in 1927.

At the Iowa Agricultural Experiment Station (8), seedings of alfalfa made in early spring gave much higher yields in the first crop year than those made in June or August. Seedings of alfalfa in early April with a nurse crop gave more satisfactory stands than seedings at the same time without a nurse crop.

In Michigan (9), questionnaires answered by farmers showed that with seedings made before June first the best results were obtained when a nurse crop was used.

Ahlgren and Graber (10) report that "of all the grasses and legumes grown in Wisconsin, 95 percent or more are sown with a companion crop".

Aamodt stated in an article by Maits (11), that over a considerable portion of the country, forage alfalfa should be sown just before or just after the time of year when weeds, moisture supply, and heat offer the seedlings their toughest fight for survival. Maits quoted Graber that in the big alfalfa growing states of Wisconsin, Michigan, and Minnesota, the bulk of the fields are most economically established by spring sowing with a nurse crop.

From an article by Lester (12), University of Missouri scientists claimed that better land is necessary for successfully establishing alfalfa sown in the spring with grain than for alfalfa sown alone in late summer.

The Iowa Agricultural Experiment Station (13), reported that the best nurse crops are short, erect-growing non-lodging

varieties which mature early and have few leaves. Spartan barley most nearly met these requirements at the Iowa station.

Collister and Kramer (14), worked with several oat varieties sown at two bushels per acre as nurse crops for red clover. They found that different varieties of oats may cause measureable differences in the stand and development of red clover plants.

Flanagan and Washko (15), used six oat varieties and Alpha barley as companion crops. Working on the basis of shadowing or light exclusion of the legume seeding, they found that greater small grain heights were related to larger losses in alfalfa and red clover stands.

Wheeler (16) states that it is best to use oats or barley for alfalfa as a companion crop rather than wheat since wheat is already well-established when the alfalfa is drilled in the spring, thus causing more competition to the seeding than either oats or barley.

King (17) found in Missouri that oats sown at the usual rate of six to eight pecks per acre and left for grain probably aren't as good a nurse crop as wheat and barley. However, oats could be made the best nurse crop of all three by seeding at the rate of four to five pecks and harvesting for hay in seasons when moisture is limiting.

According to Hafenrichter of Washington (18), the yield of alfalfa in the second year is determined by the relative vigor of the first years plants as conditioned by the different

companion crops and not by the resulting stands.

Ahlgren (19) suggests that soybeans and sudan grass should not be used as nurse crops. It appears best to prepare a seedbed and plant a hay mixture after the soybeans or sudan grass have been harvested for hay or grain.

Thatcher (20) used soybeans as a nurse crop at Wooster, Ohio. He reported, that soybeans drilled solid by the second or third week in May, and cut for hay sometime in August, gave good alfalfa stands.

## METHODS AND PROCEDURES

The experiment was conducted on the Michigan Experiment Station farm at East Lansing, Michigan, on a well drained field of Brookston clay loam. The companion crops used were Ponda, Clinton 59, and Eaton oats; Moore, Eay, and Spartan barley; German millet, Blackhawk soybeans, common sudan grass, and Silver Hull buckwheat.

The field previously in corn, was fitted in the spring of 1951 and prior to seeding, was uniformly fertilized at the rate of 400 pounds of 0-20-20 fertilizer per acre. The area was divided into randomized seven by 140 foot plots replicated four times for each crop.

The companion crops were all drilled solid; Michigan grown Grimm alfalfa was broadcast with each crop in the same operation at the rate of eight pounds per acre, and after drilling, the plots were cultipacked.

The oats and barley were sown on May 5, 1951, at the rate of two bushels per acre. The soybeans, buckwheat, sudan grass, and millet were sown on May 31, 1951. The soybeans were seeded at the rate of two bushels per acre, buckwheat at one bushel, sudan grass at 21 pounds, and millet at 28 pounds per acre.

All of the companion crops were subjected to three cutting treatments, except millet and soybeans which had two.

Harvesting the companion crops was done with a Jari mower using a three foot cutting bar. A five foot border was left on the end of the row and two feet on each side of the area cut. A  $43\frac{1}{2}$  foot section was cut for each treatment which represents  $\frac{3}{1000}$  of an acre.

The oats and barley were cut in the hay stage at three inches on July 3, 1951 and the green weight of the material was recorded. The grain cuttings were made on August 2, at two heights. The first area was cut at approximately three inches and the second area at eight to ten inches. The green weight of the grain and straw cut at three inches was recorded.

The buckwheat was cut at full bloom on August 2, at the end of bloom on August 25, and for grain on October 13; all treatments were cut at approximately three inches. The green weight of the material cut at full bloom and for grain was recorded.

Sudan grass was cut on August 2 for hay when the head was  $\frac{1}{3}$  to  $\frac{1}{2}$  out of the boot. Two cuttings were made, one at approximately three inches and the second at eight to ten inches. The green weight of the material cut at three inches was recorded. The sudan grass was cut for grain on October 13, and the green weight of the grain and straw was recorded. Where the sudan grass had been previously cut for hay a second cutting was made on October 13, both plots being cut at the same height, approximately three inches.

Both the millet and soybeans were cut for hay on August 25, and cut for grain October 13. The millet for hay was cut at approximately three inches when the crop was beginning to head. When soybeans were cut for hay, the plants were green with the lower pods about  $1/3$  filled. The green weights of both cuttings of millet and soybeans were recorded.

After the companion crops were removed, a stand count of the alfalfa was made. A square foot measure was used and five randomized counts were made in the area of each treatment with the number of plants per square foot recorded. Another stand count was made the following spring in May, 1952.

The first cutting of alfalfa from the various companion crop plots was made from June 19 to 23, 1952 when the crop was in the one-fourth bloom stage. A three foot by  $43\frac{1}{2}$  foot area was cut and the green weights were taken. Samples were taken to be dried to calculate the percent dry matter.

## RESULTS AND DISCUSSION

The green weights of the companion crops when cut at three inches in the hay and grain stage; the 1951 and 1952 alfalfa stand counts; and the yield of the first cutting of alfalfa following the various companion crops and treatments are found in Table 1 and 2.

Table 1. The Green Weight of the Small Grains When Cut at Three Inches in the Hay and Grain Stage. (Ave. of four replicates.) The Alfalfa Stand Counts in 1951 and 1952 Following the Various Treatments of the Companion Crops. (Ave. of 20 square foot counts; five in each replicate.) The Yield of the First Cutting of Alfalfa in 1952 Following the Various Companion Crops. (Ave. of four replicates.)

Crop	Green Weight	Alfalfa Stand-Plants		Alfalfa Yield
	of Comp. Crop Tons/Acre	Per Square Foot 1951	1952	1st Cutting 1952
Moore Barley				
1. Note: See end of Table	6.82	9.9	10.8	2.78
2. "	3.75	10.35	9.65	3.02
3. "	--*	6.85	7.50	2.82
Bay Barley				
1.	5.78	9.25	9.1	3.00
2.	3.23	9.85	8.6	3.13
3.	--	7.20	8.05	3.03
Spartan Barley				
1.	4.48	9.15	8.45	3.00
2.	3.44	9.35	9.9	3.11
3.	--	7.85	8.65	3.07
Eaton Oats				
1.	8.53	9.25	9.7	3.03
2.	4.63	10.25	9.75	3.07
3.	--	8.0	9.6	2.77

TABLE 1 (Continued)

Crop	Green Weight of Comp. Crop	Alfalfa Stand-Plants Per Square Foot		Alfalfa Yield 1st Cutting
	Tons/Acre	1951	1952	1952
Clinton Oats				
1.	8.05	10.15	9.25	3.06
2.	4.91	10.20	9.7	3.25
3.	--	8.6	7.9	2.92
Bonda Oats				
1.	8.73	10.3	8.95	2.97
2.	5.47	10.95	9.4	2.96
3.	--	9.1	7.8	2.86

Note: 1. With all companion crops, number 1 indicates the crop was cut for hay at three inches.  
 2. With all companion crops, number 2 indicates the crop was cut for grain at three inches.  
 3. With all companion crops, number 3 indicates the crop was cut for grain at eight to ten inches.  
 \* No attempt was made to record the green weight of the material when the companion crops were cut at eight to ten inches.

Table 2. The Green Weight of Sudan Grass, Millet and Soybeans When Cut at Three Inches in the Hay and Grain Stage; and Buckwheat When Cut at Three Inches at Full Bloom and for Grain. (Ave. of four replicates.) The Alfalfa Stand Counts in 1951 and 1952 Following the Various Treatments of the Companion Crops. (Ave. of 20 square foot counts; five in each replicate.) The Yield of the First Cutting of Alfalfa in 1952 Following the Various Companion Crops. (Ave. of four replicates.)

Crop	Green Weight of Comp. Crop	Alfalfa Stand-Plants Per Square Foot		Alfalfa Yield 1st Cutting
	Tons/Acre	1951	1952	1952
Sudan Grass				
1. Cut for hay 3 in.	6.49	11.6	12.7	2.27
2. Cut for hay 8-10 in.	--*	9.35	6.7	1.80
3. Cut for grain 3 in.	4.23	9.3	7.25	1.15

TABLE 2 (Continued)

Crop	Green Weight of Comp. Crop	Alfalfa Stand-Plants Per Square Foot		Alfalfa Yield
	Tons/Acre	1951	1952	1st Cutting 1952
Buckwheat				
1. Cut at full bloom-3 in.	7.80	14.05	13.55	2.84
2. Cut at end of bloom-3 in.	--*	10.95	10.85	2.51
3. Cut for grain-3 in.	3.56	7.35	1.55	.50
Millet				
1. Cut for hay 3 in.	8.49	10.2	9.5	2.44
2. Cut for grain-3 in.	5.72	8.15	2.55	.60
Soybeans				
1. Cut for hay 3 in.	7.81	8.75	6.8	2.43
2. Cut for grain-3 in.	1.82	5.1	2.45	.68

\* No attempt was made to record the green weight.

Bonda oats yielded the greatest total green weight of all crops when cut for hay, and Spartan barley yielded the least. Oats for hay yielded more than any of the barley varieties and out-yielded all other crops except millet which yielded more than Clinton oats, but less than Eaton or Bonda.

When cut for grain, oats out-yielded barley in all cases. Millet gave the greatest yield of all crops, and soybeans gave the least total green weight yield when cut for grain. Weights in the grain stage included the straw.

The green weights of the companion crops in Table 1 and 2 show the relationships between the crops as to their yielding ability on a green weight basis.

It is generally agreed that a good stand of alfalfa should have five to ten plants per square foot. The stand count of this experiment is found in Table 1 and 2.

It will be noted that in several cases there was a stand increase in 1952 over 1951. Different square foot areas were counted in 1952 and the counts were randomized.

In 1951, in every case where small grains were cut for grain at a three inch height, the alfalfa stand count was slightly higher than if cut for hay. The poorest stand occurred when the companion crops were cut for grain at eight to ten inches. Moore barley cut for grain at eight to ten inches gave the smallest alfalfa stand count of the small grains, while Bonda oats cut for grain at the three inch height resulted in the largest stand in 1951. Soybeans cut for grain had the smallest stand count of all the crops.

In 1952, the alfalfa stand counts made in the Moore barley cut for grain at eight to ten inches, again were the lowest while the stand in the Moore barley cut for hay was the largest of the small grains. Where buckwheat, millet, and soybeans had been cut for grain, the stand count was reduced greatly. These plants were small and could not stand the winter injury as well as the more vigorous plants. Buckwheat cut at full bloom had the largest stand count of all the crops and Sudan grass cut/  
at three inches

for hay was second highest. Buckwheat cut for grain had the least number of plants per square foot.

In the 1952 stand count, in all cases except Spartan barley, when the companion crops were cut for grain at eight to ten inches there were less alfalfa plants than when cut for grain or hay at the three inch height.

The 1951 season was apparently a good year for establishing an alfalfa seeding with a companion crop. This is evident from Table 3 and in the stand counts in Tables 1 and 2. In all cases, except when buckwheat, soybeans, and millet were cut for grain, there was an adequate number of plants in the 1952 count.

Table 3. Local Rainfall Data(21) from Mar. to Oct. 1951, Mar. to June 1952, and a 52 Average 1900 Through 1951.  
Total Monthly Precipitation in Inches.

Month	1951	1952	52 yr. ave.
Mar.	1.67	2.08	2.49
<b>Apr.</b>	2.93	3.18	2.81
May	3.08	4.71	3.67
June	3.26	1.30	3.47
July	1.07	--	2.60
Aug.	2.84	--	2.81
Sept.	2.59	--	2.98
Oct.	4.17	--	2.49

There appears to be no definite relationship between a high green weight of the companion crop and a low or high alfalfa stand count. Some crops had a low total green weight and a high alfalfa stand count and others had a low green weight and a low alfalfa stand count, and vice versa. Oats and barley are a good example of this. Although the oats yielded more green weight in both the hay and grain stage as shown in Table 1, the stand counts of the oats and barley in 1951 show that there were as many or more plants where oats were used; thus the green weight didn't appear to be a factor.

When the companion crop was cut for hay or grain at a three inch height, the alfalfa yield was greatest when Clinton oats were used. (See Table 1 and 2) When the companion crop was cut for grain at eight to ten inches the best alfalfa yield came when Spartan barley had been the companion crop.

The greatest yield of alfalfa was obtained when Clinton oats were used as the companion crop and cut for grain at a three inch height. Buckwheat, as a companion crop, cut for grain gave the least alfalfa yield based on the first cutting.

When Clinton oats were used as a companion crop, the resulting yield of alfalfa in the first cutting was greater in all treatments than the alfalfa yield where either Bonda or Eaton oats were used. Eaton oats as a companion crop and cut for hay or grain at a three inch height yielded slightly more alfalfa than when Bonda oats were used. Where the com-

panion crop was cut for grain at eight to ten inches, the resulting alfalfa yield was greater when Bonda oats were used instead of Eaton oats.

When Moore barley was used as a companion crop, it resulted in less alfalfa yield in all treatments than either Bay or Spartan barley which were almost equal in their effect upon the alfalfa.

When either the oats or barley were cut for grain at a three inch height, the alfalfa yield was as good or better than if the companion crop had been cut for hay or for grain at eight to ten inches. The alfalfa yielded practically the same when Bonda oats were cut for hay and for grain at a three inch height.

In an unfavorable season, it might be expected that the best yield would be obtained when the companion crops were cut for hay; thus reducing the competition to the seeding. In this experiment, after the companion crops were cut for hay the weather was favorable for weed growth which probably competed more than the companion crop which was left for grain.

The alfalfa yields as shown in Table 1, when oats and barley were the companion crops, varied only from 2.77 tons when Eaton oats were cut for grain at eight to ten inches to 3.25 tons when Clinton oats were cut for grain at a three inch height. The majority of the treatments ranged from about 3.0 to 3.1 tons of alfalfa per acre; so the differences were not significant. All of the alfalfa yields where small

grains were used as the companion crop would be acceptable yields.

Of the other crops used, when buckwheat was cut at full bloom, the alfalfa yield as mentioned was as high as for some of the oat and barley treatments. When sudan grass, millet, and soybeans were previously cut for hay and buckwheat cut both at full bloom and at the end of bloom, the resulting alfalfa yield the following year was over two tons per acre. All the other treatments of these crops resulted in less than two tons of alfalfa per acre. When buckwheat, millet, and soybeans had been cut for grain, many weeds came up before the first cutting of alfalfa; so the weights in Table 2 for these treatments were made up mainly of weeds and very little alfalfa.

It appears that the yield of alfalfa in the second year is determined by the relative vigor of the first years plants as conditioned by the different companion crops, but not by the stands as was found by Hafenrichter (18). In the 1952 stand counts, buckwheat cut at full bloom had 13.55 plants per square foot, while Clinton oats cut for hay had only 9.25 plants per square foot. However, the alfalfa where buckwheat was the companion crop yielded 2.84 tons per acre; while alfalfa where oats were the companion crop yielded 3.06 tons per acre. This shows that the plants were more vigorous when oats were the companion crop in the seeding year.

Figure 1 and 2 are pictures of alfalfa plants grown when buckwheat and soybeans respectively were the companion crops.



Fig. 1 Representative alfalfa plants when buckwheat was the companion crop. Left-when the buckwheat was cut at full bloom at a three inch height. Center-when buckwheat was cut at the end of bloom at a three inch height. Right-when buckwheat was cut at three inches for grain.



Fig. 2 Representative alfalfa plants when soybeans were the companion crop. Left-when soybeans were cut at three inches for hay. Right-when soybeans were cut at three inches for grain.

Figure 1 shows representative alfalfa plants from the three treatments where buckwheat was the companion crop. On the left is a plant taken from a plot where buckwheat was cut at full bloom; in the center when buckwheat was cut at the end of bloom; and the plant on the right from a plot where buckwheat was cut for grain.

Figure 2 shows the effects of soybeans on the alfalfa seeding. The alfalfa plant on the left was representative of those taken from a plot where soybeans were cut for hay and on the right when soybeans were cut for grain.

The alfalfa plants on the right in Figures 1 and 2 are representative of those from the plots where buckwheat and soybeans respectively were cut for grain. These are plants from a thin stand and of poor vigor at the beginning of 1952. The plants on the left were more vigorous and from a thicker stand. Because of their height, the lower parts of the plants were shaded and there were few leaves.

## SUMMARY

A field experiment was conducted using various companion crops, including several varieties of oats and barley, to study the establishment of an alfalfa seeding.

The best yield of alfalfa was obtained when Clinton oats were used as the companion crop and cut for grain at approximately three inches. The best alfalfa yields were obtained when oats or barley were the companion crop and cut for grain at three inches. Among all oat and barley varieties, the resulting alfalfa yield varied less than one-half ton between all treatments.

Sudan grass, millet, and soybeans cut for hay at three inches, resulted in fairly good alfalfa yields in the first cutting under the conditions of this experiment. Alfalfa yielded well the following year when buckwheat as a companion crop was cut at full bloom and at the end of bloom. Sudan grass, buckwheat, millet, and soybeans when used as companion crops and cut for grain resulted in unsatisfactory establishment and yield of alfalfa.

The alfalfa yield in the second year appeared to be a factor of the previous years vigor of the plants, as conditioned by the companion crop, but not by the resulting stand.

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