TREATING BUFFALO GRASS (BUCHLOE DACTYLOIDES) SEED TO IMPROVE ITS GERMINATION AND HOW GERMINATION IS AFFECTED BY MULCHING, TYPE OF SOIL, AND DEPTH OF PLANTING

TREATING BUFFALO GRASS (BUCHLOE DACTYLOIDES) SEED TO IMPROVE ITS GERMINATION AND HOW GERMINATION IS AFFECTED BY MULCHING, TYPE OF SOIL, AND DEPTH OF PLANTING

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Bachelor of Science

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1942

Submitted to the Department of Agronomy

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

1942

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ACKNOWLEDGEMENT

The writer wishes to express his sincere appreciation to his major advisor, Mr. H. W. Staten, Professor of Agronomy, for his constant advise, constructive criticism, and aid in securing materials; Dr. H. F. Murphy, Head of the Department of Agronomy; Dr. H. I. Featherly, Professor of Botany; and all other instructors under whom the required work was taken.

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PREFACE

Information regarding the treatment of certain hard seeded species of native grasses to improve their germination is practically unknown, and the field is relatively unexplored.

In this paper there are results of experimental data which the writer hopes will be valuable information to the field of agriculture in the Great Plains Area.

The purpose of this paper is to present preliminary experimental data in the treating of buffalo grass (Buchloe dactyloides (Nutt.) Engelm.) seed which may be useful to the western farmer in revegetating his cultivated and submarginal land to native grasses.

It cannot be too strongly emphasized that there is an immense amount of knowledge to be gained by students in the field of agriculture pertaining to the various seed treatments and how they affect germination.

INTRODUCTION

The transcontinental traveler of today would have difficulty in visualizing the western range as it was before occupancy by the white man and his domestic stock, for little virgin range remains in the western United States. Nearly a century ago the "forty-niner", on his way overland to the Pacific Coast, found a vast unspoiled natural reservoir of forage extending from the Mississippi River to the Pacific Ocean and from Canada to Mexico. Much of it at that time was called the "Great American Desert"--an immense region of rolling grassland, deserts, and mountains.

In the midst of this vast region of rolling grassland was and is today the native home of buffalo grass (Buchloe dactyloides (Nutt.) Engelm.). It is recognized by stockmen and farmers as one of the more abundant and valuable grasses of the Great Plains Area.

During the last half century, a considerable amount of this sod land has been broken out and put into cultivation. After the native sod has been disturbed by the plow, the natural revegetation process is very slow. The mistakes of our forefathers have been recognized, however, and recently scientists in agriculture have advanced new theories relative to the best use of this land. They have found that natural revegetation of cultivated land to native grasses is a slow process, and nature can be aided considerably by giving special attention to seed harvesting, processing, and treatment. Instead of requiring from 25 to 40 years to regrass

Figure 1. Regional Distribution of Buffalo Grass Showing the Sections in Which the Grass Occurs in Varying Degrees of Abundance.*

* Reproduced from Figure 4 in D. A. Savage's bulletin, Methods of Reestablishing Buffalo Grass On Cultivated Land In the Great Plains. U.S.D.A. Cir. 328:6. 1934.

a cultivated area through nature's ways, artificial methods, if carefully planned, can be used to regrass a cultivated area in 3 to 5 years' time.

In the southern Great Plains, buffalo grass ranks first among the native grasses for wind erosion control, possessing all the characteristics desired for this purpose except that of producing heavy seed crops.[1]

According to Hitchcock[2] the best known range grass in the west is buffalo grass.

On the tight dry lands of western Oklahoma, buffalo grass is considered the most drought resisting grass of the upland prairie as stated by Gernert.[3]

Native buffalo grass has many uses in its natural habitat. Practical and scientific experience has shown it an excellent grass for lawns, airports, pastures, athletic fields, golf courses, general landscaping purposes, and in many phases of soil conservation work.

"Buffalo grass is a perennial, creeping, stoloniferous, monoecious, but sometimes apparently dioecious grass, with two widely different forms of flowers. The staminate flowers consist of a one-sided spike near the summit of a long exserted stem, while the

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1 Hoover, M. M. Native and Adapted Grasses for Conservation of Soil and Moisture in the Great Plains and Western States. Farmers Bul. No. 1812: 6-7. 1939.

2 Hitchcock, A. S. Manual of the Grasses of the United States. U.S.D.A. Misc. Pub. 200: 3. 1935.

3 Gernert, W. B. Variation in Buffalo Grass. Jour. Amer. Soc. Agron. 29: 242-246. 1937.

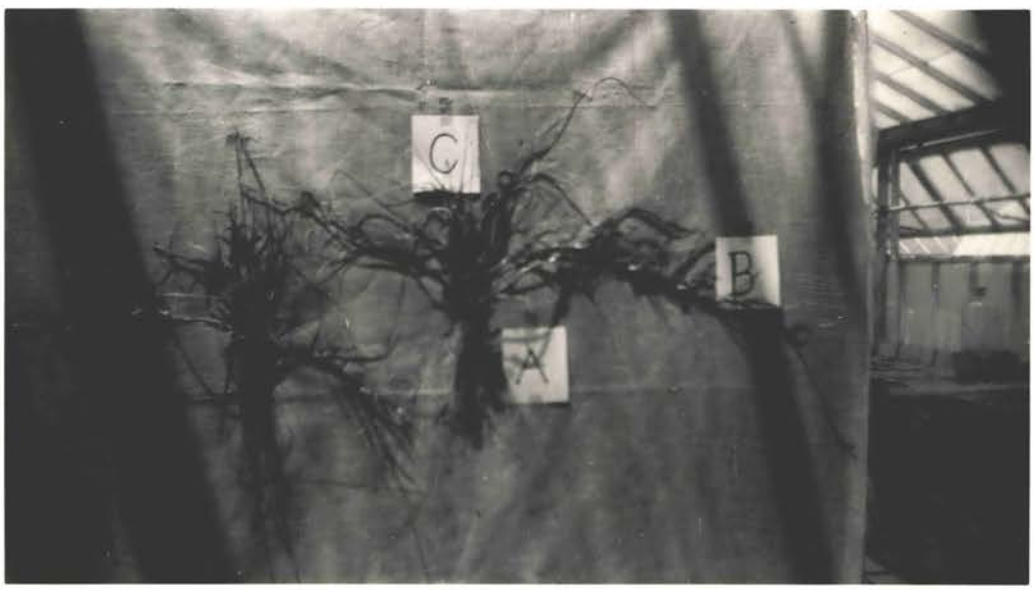

Figure 2. Buffalo Grass Plant Showing: A--roots, B--stolons or runners, and C--vegetative growth.

pistillate spikelets are on very short stems and in clusters of two or three and are scarcely exserted from the uppermost sheath."[4]

The caryopsis of this grass is enclosed in a cup-shaped structure commonly called a bur. There are from one to five hard seeded caryopses usually found in a single bur, the average being about two to three caryopses in a normal well-matured bur.

Buffalo grass spreads naturally from seed and stolons. The seed and stolons are carried by the feet of animals when the soil is moist to different parts of an area, and the process of natural propagation is speeded up when pastured by livestock.

The results in a survey made by Savage[5] show that the length of time required for the more desirable grasses fully to recover abandoned fields varies on the average from 25 to 40 or more years depending upon environmental conditions. According to these results, the length of time required for grasses to fully recover an area is too long to warrant much protection to the soil or furnish adequate grazing for livestock, so some artificial means of propagation should be employed to obtain the maximum results from the soil.

Ordinarily, buffalo grass is propagated by sod and seed. The time and labor involved in sodding large areas is immense, and from a practical standpoint, it is too laborious and costly to use except for

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4 Featherly, H. I. Grasses of Oklahoma. Tech. Bul. No. 3: 24. 1938.

5 Savage, D. A. Methods of Re-establishing buffalo grass on Cultivated Land In the Great Plains. U.S.D.A. Circ. 328: 1-9. 1934.

revegetating small areas.[6] Farmers often become discouraged in their pasture program because of the low germination of buffalo grass seed.

Instead of poor germination of the seed, some investigators think the problem is a matter of natural dormancy which can be overcome by seed treatment.

In this paper there are two phases of work dealing with buffalo grass seed germination. One deals with seed treatment in relationship to germination and the other phase with mulching, soil type, and depth of planting and their effect upon germination.

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6 Savage, D. A. Grass Culture and Range Improvement In the Central and Southern Great Plains. U.S.D.A. Circ. 491: 2-18. 1939.

REVIEW OF LITERATURE

No data can be found on how germination of buffalo grass (Buchloe dactyloides) is affected by mulching, type of soil, and depth of planting; however some material has been published dealing with the treating of buffalo grass seed to improve its germination.

Pladeck (5) in 1940 stated, "The effect on weathered burs of pre-soaking overnight in tap water or in a 0.2 percent KNO_3 solution was in one instance definitely stimulating to germination. The indications from the treatments and methods employed in preliminary trials are that burs harvested from late summer to early spring which appear to be well weathered germinate far better and show fewer dormant caryopses than samples harvested green or barely mature".

Wenger (8) found that planting two-year old seed soaked from two to four days in tap water resulted in an average field germination of 33.0 percent under adverse conditions as compared to 14.2 percent for untreated seed. Prechilling the seed dry, either treated or untreated for six weeks at 5° C., gave a significant increase in germination.

Figure 3. Native Buffalo Grass Meadow, at Price Falls, Arbuckle Mountains, in South Central Oklahoma.

BUFFALO GRASS SEED GERMINATION IN THE GREENHOUSE (Soaked and Unsoaked Seed)

MATERIALS AND METHODS

Seed harvested in 1940 and 1941 which appeared to be of high quality was put to soak in tap water at room temperature March 2, 1942. The seeds were allowed to soak 24, 48, 72, and 96 hours. At the end of each 24-hour interval, sufficient seed to plant three replicated rows was taken from the lot of both 1941 and 1940 seed and air dried as quickly as possible. All treated seed was held three weeks after treatment before being planted.

On March 21, 1942, three replicated rows of each treatment were planted in pure river sand in the greenhouse, located on the Oklahoma Agricultural and Mechanical College campus. One hundred burs were planted in each row at a depth of one inch and spaced three-fourths inch in the row with rows two and one-half inches apart. The moisture content of the sand was kept favorable for seed germination by frequent sprinkling with tap water. The experiment was conducted for a period of 60 days. All counts are expressed in terms of bur germination only because of the difficulty encountered in trying to make a single caryopsis count.

RESULTS AND DISCUSSION

The plot was observed each day after planting until the first emergences were noted. On March 27, six days after planting, the seedlings began to emerge, and counts were made thereafter every other day during the course of the experiment. The counts were made

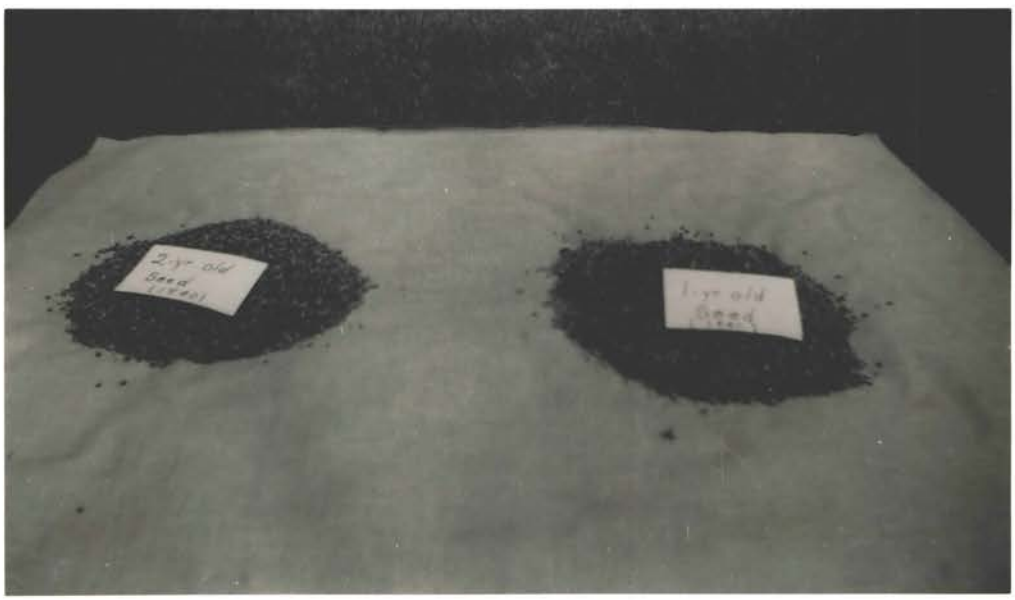


Figure 4. Buffalo Grass Seed Harvested in 1940 and 1941 As Used In Field and Greenhouse Experiments.

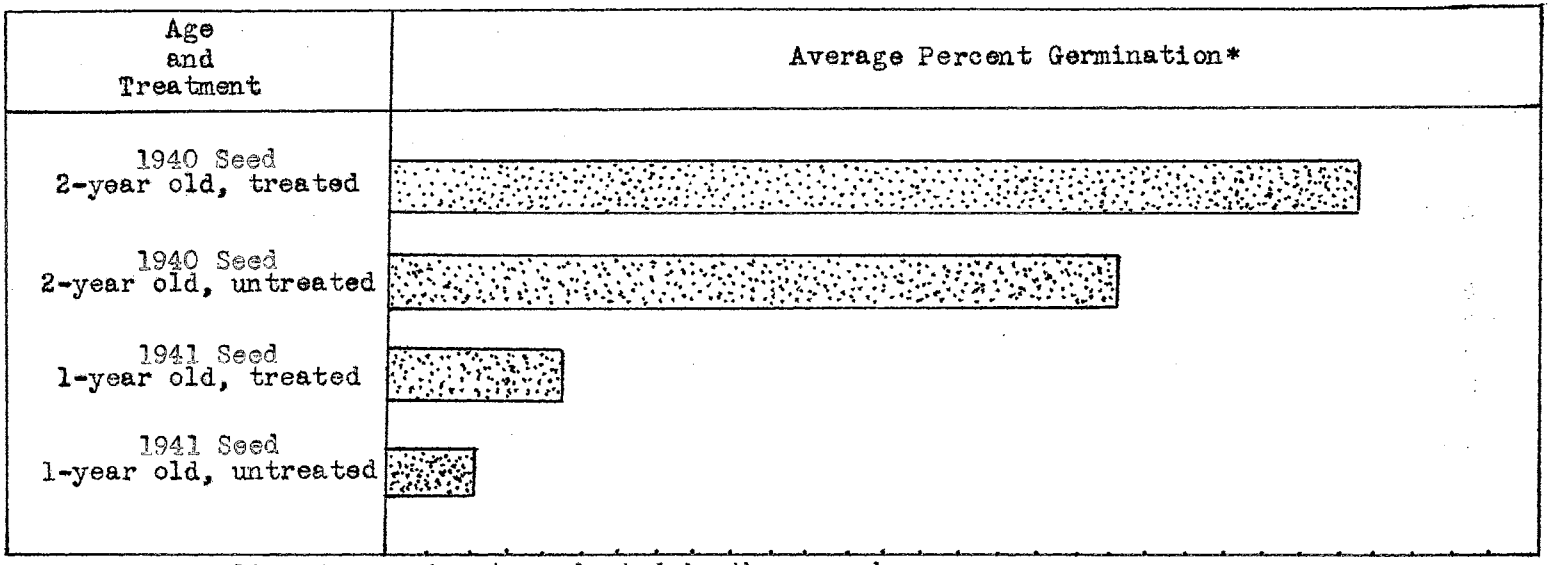
at short intervals in order to see how many days were required for buffalo grass seed to reach the highest peak of germination.

Between the 36th and 40th day after planting, the majority of the plantings had reached their high peak of germination. Very few seed germinated during the remaining days of the experiment.

From the results of this experiment, it may be concluded that buffalo grass seed germinate from six to ten days under optimum conditions and reach their highest peak of germination in approximately 36 to 40 days after planting.

The 1940 seed was far superior to 1941 seed. The average germination for the untreated 1940 seed was 18.33 percent, whereas in the 96-hour treated seed, the germination was 28 percent. In the treated 1940 seed, there was an increased average germination of 7 percent over the untreated seed. In the 1941 seed, the average germination for the untreated seed was 2.66 percent, and for the 48-hour seed treatment, the average germination was 5.33 percent. There was an increased germination of 58 percent in the treated 1941 seed as compared with the untreated seed. The 58 percent increase in germination, due to seed treatment, of the 1941 seed is not significant because of the very low percent germination of the untreated seed.

Germination results as obtained from different seed treatments are shown in Tables 1 and 2.



* Results of experiment conducted in the greenhouse.

Figure 5. Effects of treatment upon germination of buffalo grass seed.

Table 1. Germination results obtained from greenhouse plantings of 1940 soaked and unsoaked buffalo grass seed at Stillwater, Oklahoma.*

Replication Rows	Percent bur germination by Treatment					Average Germination Percent
	None	24 hrs.	48 hrs.	72 hrs.	96 hrs.	
1	18	29	19	27	32	
2	21	20	19	19	24	
3	16	25	28	25	28	
Average	18.33	24.66	22.00	23.66	28.00	23.06

* Germination for a period of 60 days after planting.

Table 2. Germination results obtained from greenhouse plantings of 1941 soaked and unsoaked buffalo grass seed at Stillwater, Oklahoma.*

Replication Rows	Percent bur germination by Treatment					Average Germination Percent
	None	24 hrs.	48 hrs.	72 hrs.	96 hrs.	
1	2	6	3	3	7	
2	3	4	4	6	3	
3	3	4	9	3	3	
Average	2.66	4.66	5.33	4.00	4.33	4.19

* Germination for a period of 60 days after planting.

BUFFALO GRASS SEED GERMINATION IN THE FIELD (Soaked and Unsoaked Seed)

MATERIALS AND METHODS

Seed of the same lot, age, and treatment as used in the greenhouse experiment previously mentioned was planted in the field on fallow soil at two different dates to determine the bur germination under field conditions. The 1940 and 1941 seed were withheld for three weeks after soaking before being planted just as were the seed which were used in the greenhouse experiment.

On May 2, 1942, and May 20, 1942, three replicated rows of each treatment were planted in field plots 10 by 16½ feet. The burs were planted in 10-foot rows with 100 burs to each row and at a uniform depth of one inch. The rows were spaced one foot apart with one row of the 1940 seed alternating with one row of the 1941 seed.

A special constructed apparatus for planting the burs at a uniform depth of one inch was made by drilling 100 holes 5/16 inch in diameter in a 1 by 2 inch pine strip 10 feet long and using wooden pegs one-fourth inch in diameter inserted in a 3-inch portion of a broom handle as a gage puncher. The gage puncher was so constructed that when the one-fourth inch peg was passed through the 5/16-inch hole in the 10-foot strip, it left one inch of the peg protruding from the ventral side of the 10-foot strip. This placed all the seed at a uniform depth of one inch below the surface of the soil as shown in Figure 6.

Figure 6. Equipment Used in Field Plantings.

The moisture was favorable immediately following both planting dates. When moisture was not adequate for maximum results, the plots were watered with tap water every other day. In the latter days of the experiment, the rainfall was sufficient to promote optimum results because of frequent rains.

Foreign species of grasses and undesirable plants were rogued from the plots. Cultivation with a garden plow, using special constructed equipment to guard against covering and disturbing small grass seedlings, was done at intervals sufficient to warrant eradication of undesirable vegetation and to loosen the soil.

Emergence counts were made every third day on all plots during the period of the experiment. The counts were made as long as an increased germination continued, but when the readings ceased to show any change for several successive counts, it was assumed that the percent bur germination had reached its peak.

RESULTS AND DISCUSSION

Seedlings from the May 2, 1942, planting began to emerge May 9, 1942. Seedlings from the May 20th planting started emerging May 31, 1942. The early date of planting started germination four days sooner than the later planting; however the length of time required to reach the highest peak of germination was practically the same in both cases, which was 32 to 40 days after planting.

The germination results obtained from field plantings of soaked and unsoaked buffalo grass seed are very similar to results obtained under greenhouse conditions. In the greenhouse and field,

Figure 7. Method Employed in the Cultivation of Experimental Plots with Buffalo Grass Seed.

96-hour soaking treatment gave the highest percentage bur germination in the 1940 seed. The average percent bur germination for the 96-hour soaking treatment in both 1940 and 1941 seed is practically the same for the greenhouse and field experiments.

The average germination for the untreated 1940 seed was 15.5 percent, whereas in the treated seed the average germination was 21.4 percent.

In the 1941 untreated seed, the percent of bur germination was 1.6 as compared with 3.4 for the treated seed.

The May 20th planting gave the highest germination count in the majority of all soaking treatments both for the 1940 and 1941 seed. The May 20th planting gave the highest average percent germination for the 1940 and the 1941 seed. The May 20th planting gave an increased bur germination of 1.1 percent in the 1941 seed and 1.3 percent in the 1940 seed over the May 2nd planting.

Germination results as obtained from different seed treatments planted on two different dates are shown in Tables 3 and 4.

Figure 8. General View of Field Experimental Plots of Buffalo Grass Seed.

Table 3. Germination Results obtained from field plantings of soaked and unsoaked buffalo grass seed, at Stillwater, Oklahoma.*

Planting Date	Replication Rows	Percent bur germination by various treatments					Average Germination Percent
		None	24 hrs.	48 hrs.	72 hrs.	96 hrs.	
May 2, 1942	1	15	26	18	14	25	
	2	13	15	15	23	31	
	3	14	7	17	12	28	
	Average	14.0	19.3	16.6	16.3	28.0	18.8
May 20, 1942	1	12	12	27	30	27	
	2	9	23	15	19	25	
	3	6	16	24	24	33	
	Average	9.0	17.0	22.0	24.0	28.3	20.1
Grand Average		11.5	18.1	19.3	20.3	28.1	19.4

* Results from seed harvested in 1940.

Table 4. Germination results obtained from field plantings of soaked and unsoaked buffalo grass seed, at Stillwater, Oklahoma.*

Planting Date	Replication Rows	Percent bur germination by various treatments					Average Germination Percent
		None	24 hrs.	48 hrs.	72 hrs.	96 hrs.	
May 2, 1942	1	2	3	1	3	2	
	2	2	2	2	3	5	
	3	2	1	2	2	3	
	Average	2.0	2.0	1.6	2.6	3.3	2.7 — 2.3
May 20, 1942	1	1	2	7	4	6	
	2	2	1	6	2	7	
	3	1	5	8	3	3	
	Average	1.3	2.6	7.0	3.0	5.3	3.8
Grand Average		1.6	2.3	4.3	2.8	4.3	3.0

* Results from seed harvested in 1941.

BUFFALO GRASS SEED GERMINATION IN THE FIELD (Soaking, prechilling, and laboratory treatment with 0.2% Potassium nitrate solution)

MATERIALS AND METHODS

The same general lot of seed previously mentioned in the greenhouse and field tests was used in this experiment. Both 1940 and 1941 seed were treated before prechilling by soaking one lot in tap water and another lot in 0.2 percent solution of potassium nitrate at room temperature for 24 hours, 48 hours, 72 hours, and 96 hours, respectively. At the end of each 24-hour interval, sufficient seed to plant two rows of each treatment was taken from the water and the 0.2 percent potassium nitrate solution and air dried as quickly as possible.

On March 3, 1942, both treated and untreated seed were placed in small glass vials and set in the refrigerator. The refrigerator was thoroughly checked and set at 5° C. two days before beginning the six-week period of prechilling. The temperature was checked every few days and kept as near the 5° C. mark as possible.

Two samples of each of the 1940 and 1941 seed were prechilled moist by placing the seed in glass cover plates. Two of the plates were kept covered with water and the other two with the 0.2 percent potassium nitrate solution. Sufficient amounts of tap water and potassium nitrate solution were added during the six-week period to furnish adequate moisture for the burs to be prechilled moist. A more detailed explanation of the methods and laboratory tests are shown with the results in Tables 5 and 6.

Table 5. Germination results obtained from field plantings on fallow soil of soaked and unsoaked buffalo grass seed with and without a period of prechilling (5° C.)*

Length of Soaking Treatment	Laboratory Treatment	Percent Germination of Viable Burs	
		Water	Potassium Nitrate
None	None	17	--
	Prechilled Moist Six Weeks	26	42
	Prechilled Dry Six Weeks	21	--
	None	20.5	26
24 hours	Prechilled Dry Six Weeks	28	36
	None	32	24
48 hours	Prechilled Dry Six Weeks	25	37
	None	22	26
72 hours	Prechilled Dry Six Weeks	34	17
	None	9	7
96 hours	Prechilled Dry Six Weeks	9	13

* Results from seed harvested in 1940.

Table 6. Germination results obtained from field plantings on fallow soil of soaked and unsoaked buffalo grass seed with and without a period of prechilling (5° C.)*

Length of Soaking Treatment	Laboratory Treatment	Percent Germination of Viable Burs	
		Water	Potassium Nitrate
None	None	3	--
	Prechilled Moist Six Weeks	19	36
	Prechilled Dry Six Weeks	5	--
24 hours	None	4	7
	Prechilled Dry Six Weeks	2	4
48 hours	None	3	5
	Prechilled Dry Six Weeks	3	3
72 hours	None	3	6.5
	Prechilled Dry Six Weeks	2.5	14
96 hours	None	1	4.5
	Prechilled Dry Six Weeks	3.5	17.5

* Results from seed harvested in 1941.

At the end of the six-week prechilling period, the seed which were prechilled moist were air dried as quickly as possible and the entire lot of prechilled seed was withheld from planting for two weeks. On May 2 and 4, 1942, the seed were planted in the field on fallow soil in plots 10 by 16½ feet. They were planted in 10-foot rows with 100 burs to each row and at a depth of one inch. The same equipment and technique as previously described were employed in planting all treated and untreated seed. The plantings were made two days apart because of adverse weather conditions during the time. It is very doubtful whether or not the two-day difference in the planting date would have any direct influence upon the percent bur germination of the two plantings, because for each planting date the first emergence of the seedlings was recorded on the sixth day after planting.

Undesirable weeds and grasses were rogued from the plot at intervals, and cultivation with a garden plow was employed, as necessary, to keep down undesirable vegetation during the course of the experiment.

There was a short dry period following two weeks after planting, and it was necessary to water the plots at regular intervals during that period in order to supply sufficient moisture for optimum bur germination. In the latter days of the experiment, the rainfall was sufficient to furnish adequate moisture, as it rained nearly every other day.

This observation was carried on for seven weeks, and emergent counts were made at three-day intervals from the date of the first emergence throughout the duration of the experiment.

RESULTS AND DISCUSSION

On May 9, 1942, seven days after planting, the seedlings began to emerge from the plots planted May 2. Two days later emergences were showing up on all plots planted with laboratory-treated seed. From the day of the first recordings, counts were made at three-day intervals throughout the length of the experiment. High peak germination of the 1940 prechilled seed was reached in 21 days.

Seedlings from the prechilled seed showed a more uniform emergence, and the plants developed more rapidly than the seedlings from seed which were not prechilled.

On June 24, 1942, the day the final counts were made, several of the six-week old plants from the prechilled seed produced stolons from one to three inches in length, whereas seedlings from seed not prechilled only occasionally showed evidence of stolons. The seedlings from prechilled seed were easily detected from the seedlings from seed which received no prechilling treatment by their vegetative growth.

The average germination for seed pretreated by soaking in a 0.2 percent potassium nitrate solution, either prechilled or not prechilled, was somewhat higher for the 1940 and 1941 seed than seed pretreated by soaking in tap water for one to four days. The average germination for all prechilled seed, either soaked in tap water or in 0.2 percent potassium nitrate solution, was higher than seed which received no prechilling treatment.

Prechilling the 1940 and 1941 seed moist in 0.2 percent potassium nitrate solution gave the highest results of any treatment used in all the seed-treating experiments. Soaking the 1941 seed

moist for six weeks gave a 36 percent bur germination as compared with 3 percent for the untreated seed. When the 1940 seed was prechilled moist in a 0.2 percent potassium nitrate solution, there was an increased bur germination of 25 percent over the untreated seed.

The results obtained from the 1940 and 1941 seed which were prechilled moist in a 0.2 percent potassium nitrate solution are in accordance with the results of Wenger (8) in his prechilling treatment. His results were somewhat higher probably because of the difference in the methods employed in germination. Wenger germinated the seed on paper toweling moistened with a 0.2 percent potassium nitrate solution, while the results presented here were obtained by planting the seed at a uniform depth of one inch in the field in fallow soil. The wide differences in percent of bur germination in this experiment and that of Wenger's is probably due to the factor involving depth of planting as described under "Field Test of Seed as Affected by Mulching, Soil Type, and Depth of Planting".

Soaking the 1941 seed for 72 and 96 hours before prechilling had a tendency to increase the percent of bur germination, but in the 1940 seed, there was a decrease in the percent of germination when it was presoaked for these periods before prechilling. In all the treatments, the 1940 seed gave considerably higher responses than the 1941 seed to soaking in tap water or 0.2 percent potassium nitrate solution from one to four days before prechilling, with the exception of the treatment in which the seeds were prechilled moist in 0.2 percent potassium nitrate solution. The 1940 seed resulted in a 42 percent bur germination as compared with a 36 percent bur germination for the 1941 seed. Results and methods of treatment are shown in Tables 5, 6, and 7.

Table 7. The effects of soaking buffalo grass seed in tap water, 0.2 percent potassium nitrate solution, prechilling, and not prechilling.*

Date of Harvest	Average Percent Germination			
	Soaked in Water	Soaked in 0.2 Percent Potassium Nitrate	Prechilled Six Weeks at 5° C.	Not Prechilled
1941 Seed	4.5	10.8	9.9	4.2
1940 Seed	22.4	25.3	26.1	20.8

* Results obtained from average of field experiment data.

GERMINATION OF BUFFALO GRASS SEED AS AFFECTED BY MULCHING, SOIL TYPE, AND DEPTH OF PLANTING

MATERIALS AND METHODS

In the latter part of February, 1942, at the Oklahoma Agricultural and Mechanical College agronomy farm, Stillwater, all soil from an area 8 by 24 feet was excavated to a depth of 18 inches. This rectangular pit was divided into three 8-foot series and was further subdivided into separate compartments by means of 18-inch heavy tin strips.

Surface soils of Kirkland silt loam and a Vernon sandy loam were placed in two of the 8-foot series of the 24-foot rectangular pit. A portion of the original soil which was removed in the excavation was thoroughly mixed and placed in the third 8-foot series.

The original soil from the excavation after being thoroughly mixed within itself was an intermediate soil between the Kirkland and Vernon and was classified as a very fine sandy loam. The three different soils were firmly packed and settled by rains which occurred several times after preparing the plots during the period which elapsed before the plantings were made.

Each 8-foot series were divided into sixteen 2 by 2 foot plots by the installation of cross partitions made of heavy tin.

On May 7, 1942, Oklahoma buffalo grass seed harvested in 1935 was planted on all three soil types at two uniform depths, namely one inch and one-half inch. In eight plots of each series, 200 burs were planted at a uniform depth of one-half inch, and on the other eight plots of the same series, 200 burs were planted at a uniform

depth of one inch. A square 200-seed dropboard used in the experiment was made by drilling two hundred 5/8-inch holes in a square heavy cardboard 23 by 23 inches. The seed was planted at a uniform depth by dropping the burs through the holes in the dropboard and punching them at the desired depth with a gage puncher constructed similar to the puncher described in "Materials and Methods" in Field Experiment Number 1.

On four of the one-inch plantings and four of the one-half inch plantings in each series, a straw mulch was placed on the surface of each plot just thick enough to obstruct the surface view of the soil, approximately 1/8 to 1/4 inch deep. In each series there were four mulched one-half-inch plots, four unmulched one-half-inch plots, four mulched one-inch plots, and four unmulched one-inch plots. The depth of plantings and mulching was planned on the checkerboard style as shown in Figure 9, making four replication plots of each treatment on all three soil types.

The plots were well watered upon completion, and the moisture content of the soil was kept favorable for plant growth by frequently sprinkling with tap water. In the latter three weeks of the experiment no sprinkling was required because the rainfall was adequate for optimum germination.

None of the plots received any cultivation throughout the course of the experiment. The soil was slightly disturbed when the undesirable and competitive vegetation was removed from the plots. The experiment was in process for six weeks, and emergence counts were made at regular 3-day intervals throughout the length of the experiment.

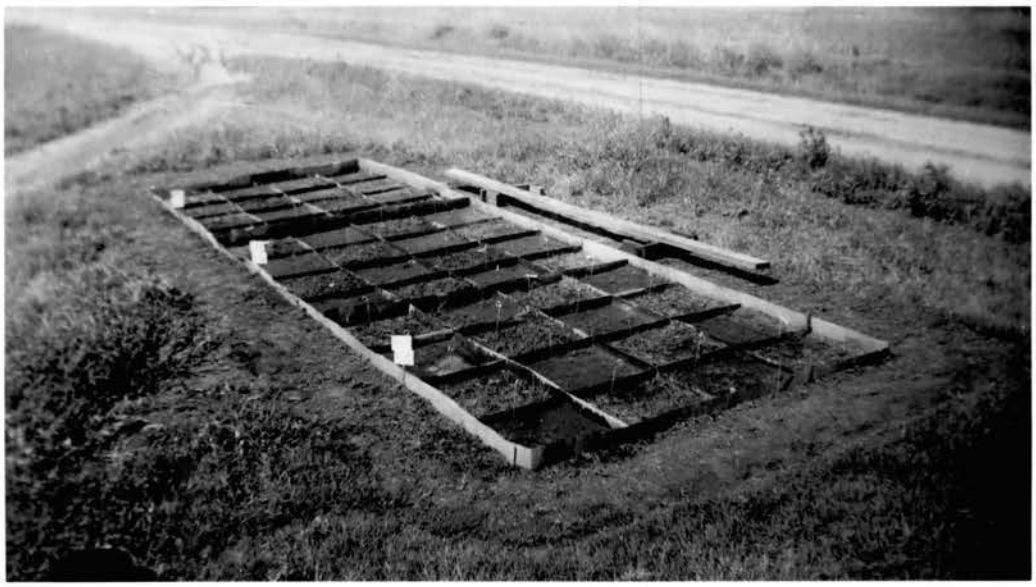


Figure 9. Experimental Plots Dealing With Mulching, Soil Type, and Depth of Planting.

All counts are expressed in terms of bur germination because of the difficulty encountered in trying to make a caryopsis count.

A strip 2 feet wide around the experimental enclosure was kept free of vegetation by frequent cultivation and was sprinkled each time the plots were watered.

RESULTS AND DISCUSSION

The data presented in this paper indicate that mulching, soil type, and depth of planting have a direct influence upon the percent bur germination of buffalo grass seed.

The plots were observed each day until the first emergences were noticed, and after that date emergent counts were made at regular 3-day intervals. These short interval readings made it possible to determine the rate of germination on each soil type and the approximate number of days for the seed to reach the high peak germination.

On May 16, 1942, the first emergences were recorded on all three soil types. The one-half-inch planting produced the highest percent of bur germination. In approximately three weeks after planting, the emergences in the majority of the plots tended to make little increase from one 3-day interval to the next, and the greater part of the plots had almost reached their highest germination for the period of observation.

The average bur germination on the mulched plots in all three series was 28.9 percent as compared with 21.2 percent for the non-mulched plots. The mulched plots on all three series with seed planted one-half inch deep produced the highest percent of bur germination of any of the treatments. The mulched plots with seed

Figure 10. Buffalo Grass Seedlings on 2 x 2' Silt Loam Kirkland Soil Planted at a Depth of One-Half Inch and Covered With a Light Straw Mulch on the Surface of Soil. Planted May 7 and Photographed June 20, 1942.

Figure 11. Buffalo Grass Seedlings, a 2 x 2' Plot on Silt Loam Kirkland Soil Planted at a Depth of One-Half Inch and Receiving No Light Straw Mulch on Surface of Soil. Planted May 7 and Photographed June 20, 1942.

planted one inch deep ranked second with an average bur germination of 23.9 percent as compared to 19.5 percent germination for the non-mulched plots at the same depth of planting. The lowest percent bur germination obtained on all three series was on plots which were not straw mulched. Seedlings growing in plots which had been mulched with straw were more vigorous, and the spreading of the plant by the production of stolons was more rapid. From the results of this experiment, buffalo grass seed planted with a light straw mulch produces a greater percent of seedlings, and the vegetative growth of the plant is hastened, causing the grass to occupy an area by natural means in a shorter length of time. The effect of mulching and non-mulching on the percent of germination of buffalo grass seed is shown in Table 8. The data shown in the following tables are summarized from results of the final emergence counts on four replicated plots of each treatment and are expressed in terms of percent of bur germination.

The average percent bur germination of the one-half-inch mulched plantings on all three soil types was considerably higher than on the one-inch mulched plantings. The one-half-inch non-mulched plantings were also higher than in the one-inch non-mulched plantings. On all three series, the average bur germination on all one-half-inch plantings was 28.5 percent as compared to 21.7 average percent of bur germination on all the one-inch plantings. The effect of depth of planting on the percent germination of buffalo grass is shown in Table 9.

The influence of soil type upon the percent of bur germination of buffalo grass seed has been clearly demonstrated, and results of recent experimental work indicate that regardless of depth of planting or presence of straw mulch, the percent of bur germination is partially determined by the type of soil. Results of experimental data show that

Table 8. The effect of mulching and non-mulching on the percent germination of buffalo grass seed.

Treatment	Average Percent Bur Germination			Average
	Kirkland Soil	Vernon Soil	Mixed Soil	
Mulched Seeded $\frac{1}{2}$" deep	41.1	35.0	26.5	34.0
Mulched Seeded 1" deep	28.1	28.5	15.1	23.9
				28.9*
Non-Mulched Seeded $\frac{1}{2}$" deep	24.6	23.6	20.5	22.9
Non-Mulched Seeded 1" deep	24.3	18.7	15.5	19.5
				21.2**

* Average percent bur germination on all mulched plantings.
** Average percent bur germination on all non-mulched plantings.

Table 9. The effect of depth of planting on the percent germination of buffalo grass seed.

Depth of Planting	Average Percent Bur Germination			Average
	Kirkland Soil	Vernon Soil	Mixed Soil	
½ inch Mulched	41.1	35.0	26.5	34.2
½ inch Non-Mulched	24.6	23.6	20.5	22.9
				28.5*
1 inch Mulched	28.1	28.5	15.1	23.9
1 inch Non-Mulched	24.1	18.7	15.5	19.5
				21.7**

* Average percent bur germination on all ½-inch plantings.
** Average percent bur germination on all 1-inch plantings.

Kirkland soil supported a higher percent of bur germination of buffalo grass seed than either Vernon or mixed soil and that Vernon soil in each case, regardless of mulch or depth of planting, was superior to mixed soil. The average percent bur germination on all plantings in the Kirkland soil was 29.5 percent as compared with 26.4 percent for the Vernon and 19.4 percent for the mixed soil. The effect of soil type on the percent germination of buffalo grass seed is shown in Table 10.

The writer is not interested in the chemical and physiological explanation as to why the percent of bur germination of buffalo grass seed is affected by soil type but is only concerned from the practical side of the question. It is hoped that results of these investigations may lead to a better understanding of how, when, and where to plant buffalo grass seed to obtain optimum results and also to help the western farmer with some of his problems concerning the propagation of buffalo grass by seed.

Table 10. The effect of soil type on the percent germination of buffalo grass seed.

Depth of Planting and Surface Treatment	Average Percent Bur Germination			
	Kirkland Soil	Vernon Soil	Mixed Soil	Average
½ inch Mulched	41.1	35.0	26.5	34.2
½ inch Non-Mulched	24.6	23.6	20.5	22.9
1 inch Mulched	28.1	28.5	15.1	23.9
1 inch Non-Mulched	24.3	18.7	15.5	19.5
Average Percent*	29.5	26.4	19.4	25.1**

* Average percent bur germination of 16 replication squares on each of the three soil types.

** Average percent bur germination on all 48 replication squares including all three types of soil.

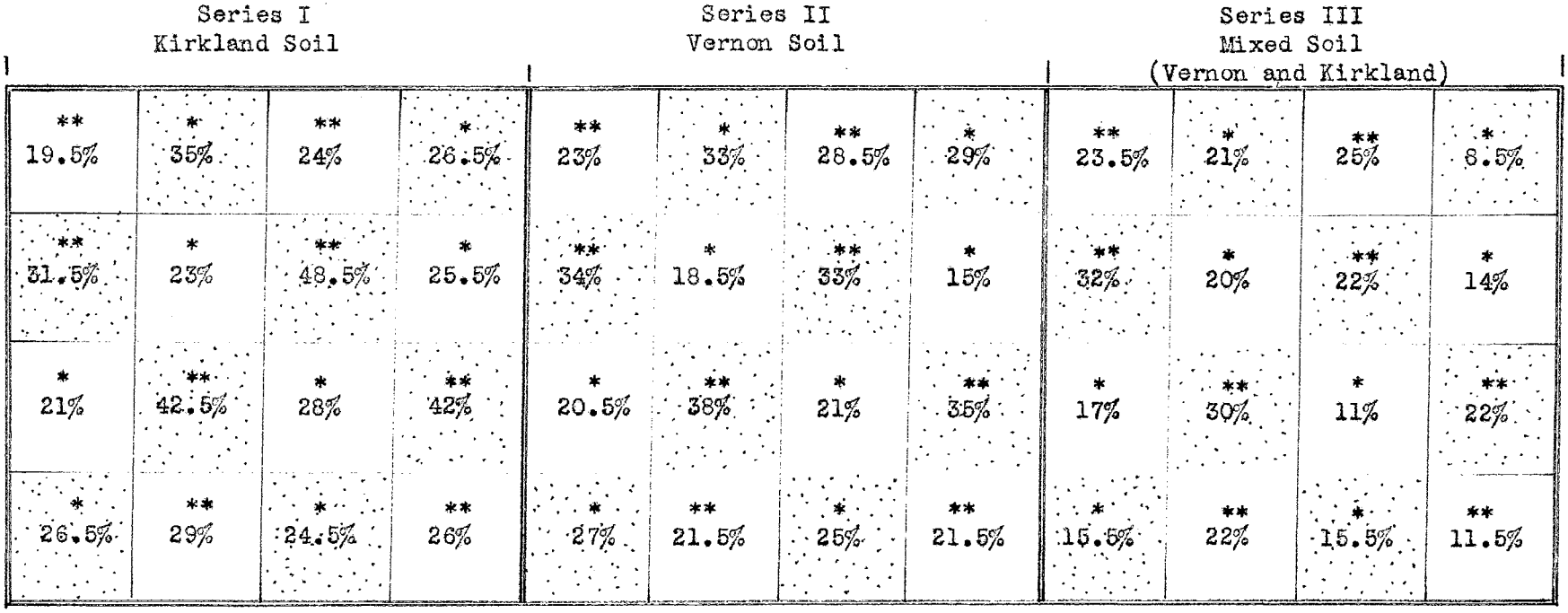


Figure 12. Drawing shows plot arrangement and percent germination of buffalo grass experiment which includes mulching, soil type, and depth of planting.

* Seed planted one inch deep.
** Seed planted one-half inch deep.

Straw Mulched
Non-Mulched

Scale in Feet
0 2 4 6 8

SUMMARY AND CONCLUSIONS

1. Buffalo grass seed, in the burs, begin to emerge from 6 to 12 days and reach their highest peak of germination from 30 to 40 days under both greenhouse and field conditions.

2. Soaking buffalo grass seed in tap water for 1 to 4 days followed by immediate air drying increased the percent of bur germination in 1940 and 1941 seed.

3. The 96-hour soaking treatment gave the highest results in both 1940 and 1941 seed under greenhouse and field conditions, with the exception of the 48-hour soaking treatment of the 1941 seed planted under greenhouse conditions.

4. Buffalo grass seed soaked in a 0.2 percent potassium nitrate solution for 1 to 4 days and prechilling for six weeks at 5° C. gave an increased percent of bur germination over either untreated seed or seed pretreated by soaking in tap water for 1 to 4 days.

5. Both 1940 and 1941 buffalo grass seed prechilled moist in a 0.2 percent potassium nitrate solution for six weeks at 5° C. gave the highest percent of bur germination. Seedlings from seed of this treatment were more vigorous and the emergences were more uniform than seedlings from any of the other treatments.

6. Buffalo grass seed harvested in 1940 and 1941 and receiving no treatment gave the poorest germination.

7. Mulching the seedbed with a light straw mulch increased the percent of bur germination over the non-mulched regardless of depth of planting or type of soil.

8. Seed planted one-half inch deep either mulched with light straw mulch or non-mulched gave a higher percent of bur germination than seed planted one inch deep and receiving no mulch.

9. Buffalo grass seed planted one-half inch deep and mulched with a light straw mulch produced the highest percent of bur germination on all three soil types, and for all practical purposes, this is to be highly recommended in propagating buffalo grass by seed.

10. The percent of bur germination in buffalo grass seed is partially influenced by the type of soil. Regardless of depth of planting or presence of straw mulch, these results indicate that soil type is an influencing factor in the germination of buffalo grass seed. Kirkland soil gave a higher percent germination than either Vernon or mixed, and Vernon was superior to mixed soil.

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Typist: Mrs. James H. Carter