THE EFFECT OF CERTAIN ADDITIVES ON THE GERMINATION OF PELLETED GRASS SEED

BY

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Bachelor of Science

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1946

Submitted to the faculty of the Graduate School of
the Oklahoma Agricultural and Mechanical College
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1953

THE EFFECT OF CERTAIN ADDITIVES ON THE GERMINATION
OF PELLETED GRASS SEED

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ACKNOWLEDGEMENT

I wish to express my sincere appreciation to my major adviser, Dr. Jack R. Harlan and to Charles Denman for their guidance and constructive criticism; Dr. Frank Graybill of the mathematics department for his assistance in the statistical analyses. My thanks are due to J. D. Bilbro and to Miller Feibel for their interest and help in the preparation of pelleted seed.

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January, 1953

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INTRODUCTION

Pelleting of seed for higher germination and better stands of grass is a relatively new means of treatment for seeds. The shortage of grass seed has brought about a renewed interest in the treatment of seeds and in other methods whereby better stands could be obtained.

A greatly expanded grassland improvement program involving reseeding permanent pastures and ranges, seeding more and better grasslands in the rotation, will be retarded without an increase in grass seed production and more efficient use of seed available.

The successful establishment of a good stand of grass is difficult unless good production practices are used. For this reason it is highly important that methods be used to increase germination and get the best possible stands.

Little work has been done on the pelleting of grass seed, therefore, the data are limited. There are no general recommendations available as to the proper amounts of fertilizers, fungicides, insecticides or other additives which should be added to the pelleting material.

Should the pelleting of grass seed, with the incorporation of additives, increase the germination and stand of grasses, they will be of great use in the reseeding program that is underway. Possibly one of the great advantages would be in the successful establishment of grass nurseries for research studies.

The primary object of this experiment was to determine the effect of different additives on the germination and establishment of stands of grasses from pelleted seed.

REVIEW OF LITERATURE

According to Wagner and Kinkor 90,000 acres were seeded on range lands in New Mexico and Arizona by the airplane pellet method with the result that the operation is directly proportional to the amount of ground preparation, other factors being equal, and that seeding with unpelletized seed gave approximately the same results as seeding with pelletized.[1]

Henry states that under ideal conditions the airplane method of seeding with pellets can cover a 250 feet strip, four miles long in one minute, thus reducing costs to around $1.75 per an acre.[2]

Wagner reports that actual mechanical injury to wheatgrass, brome and similar seed decreases their viability by varying degrees. Crested wheatgrass, Agropyron cristatum (L) Beauv.[3], when tested by the state seed analyst at the University of Wyoming, dropped from a germination of 80.68% before pelleting, to 14.7% after pelleting.[4]

Henderson stated that the pellets are not only an easier size and weight to sow by hand or with planter, but the chemicals also protect the seed against soil-borne organisms and provide the plant nutrients

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[1]"Will Pellet Seeding Work," American Forestry, XLVI (May, 1950),25.

[2]"Planes Rain Seed Pellets on Arizona Desert," American Forestry, (March, 1947), 120.

[3]H. I. Featherly, Manual Of The Grasses Of Oklahoma, (Stillwater, Oklahoma, August, 1946),20.

[4]"Results Of Airplane Pellet Seeding On Indian Reservations," Journal Forestry, LVII (April, 1949), 632.

the tiny seedlings need to get a vigorous start in life. The end result is a dependable stand of plants without sowing seed more thickly than the plants should grow.[1]

Carew reports that the pelleting of vegetable seed has a promising future. However, much more research is necessary to determine the best combination of coating material, fertilizer, and fungicide for each kind of seed.[2]

The advantages according to Navlet are: thinning costs are either entirely eliminated or substantially reduced; there are no transplanting costs; vegetable plants mature quicker; plants from pelleted seed consistently produce better yields; infection and spread of disease is reduced and insecticides may be incorporated in the coat to provide protection against wireworms and cutworms.

The disadvantages in some cases are: a slightly delayed emergence of the plant; the lack of significantly consistent improvement when growth promoting substances are included in the coating process; fertilizer incorporated up to the point of being toxic to the seed has not been too encouraging, and the tendency to sow the enlarged seed too deep affects germination.[3]

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[1]"Pills For Your Garden," Garden Chronicle, LXII (January, 1948), 5.

[2]"Pelleted Seeds Need More Research," N.Y. State Agri. Exp. Farm Res., XV (April, 1949), 16.

[3]"Coated Seed is Vital Farm Mechanization Link," Agricultural Leaders Digest, XXXI (March, 1950), 18.

Rudolph, in his work with the pelleting of seed of jack pine, Pinus Banksiana Lamb, found that it was possible to obtain germination from some commercially pelleted jack pine seed equal to that from unpelleted seed. He states that unless there is some advantage beyond satisfactory germination, the added cost of pelleting does not seem justified.[1]

Meulen states that the coating protects the seed during hot, dry periods when it must lie dormant, and also when there is too much moisture and the naked seed would be flooded out or rot in the wet ground.[2]

Allen found in comparing two types of crested wheatgrass pellets, that where the Adams process was used for making the pellet, 14.7% germination was recorded, as against 86% germination for the original seed. The Adams process consists of forming a pellet by pressing into a mold a mixture of crested wheatgrass seed and clay. Pellets formed by the "Midland" coating process, a process by which pellets were formed by placing seed in a rotating drum and laying the material down in a spiral cover around the seed, the germination test was 94%, as compared to 89% germination for the original seed.[3]

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[1]"A Test Of Pelleted Jack Pine Seed," Journal of Forestry, LVIII (October, 1950), 703.

[2]"Seeds In Coats," Farm Quarterly IV, (Winter, 1950), 58.

[3]"A Comparison Of Two Types Of Crested Wheatgrass Pellets," Proceedings Of The Association Of Official Seed Analysts. (1949), 72-73.

MATERIALS AND METHODS

Pelleted seed investigations were conducted in the greenhouse at Stillwater, Oklahoma during the summer and fall of 1952, to determine the effect of certain additives on the germination of pelleted grass seed.

These investigations included smooth brome, *Bromus inermis* Leyss, sand bluestem, *Andropogon hallii* Hack, switchgrass, *Panicum virgatum* L and sand lovegrass, *Eragrostis trichodes* (Nutt) Nash.[1] The additives incorporated into the pelleting material were:

Arasan (Tetramethylthiuram disulfide)
Systox
Ammonium nitrate (33%)
Superphosphate (20%)
Muriate of Potash (50%)
5-10-5 fertilizer

One treatment consisted of pelleted seed without an additive, which was used as a check.

One-half pound samples of each of the four species of grass were divided by a Dean Gamut precision divider into 64 uniform samples. From these samples, one was drawn at random for each of the 7 treatments within the four replications used.

The material used for the pelleting of seed was a finely ground powder form of montmorillinite furnished by the Filtrol Corporation of California and sold under the trade name of Filcoat.

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[1]H. I. Featherly, *Manual of the Grasses of Oklahoma,* (Stillwater, Oklahoma, August, 1946)

The additives were added to the filcoat at different rates according to general recommendations for unpelleted seed. Arasan was added to the filcoat at the rate of 2 ounces for 56 pounds of seed or 1 gram of arasan to 450 grams of filcoat. Systox was added to filcoat at the rate of 4 pounds per acre, or 4 ounces to 5 gallons of water. Superphosphate was added at the rate of 200 pounds per acre, or 26.1 grams of superphosphate to 450 grams of filcoat. The 5-10-5 fertilizer was applied at the rate of 200 pounds per acre, or 26.1 grams of 5-10-5 to 450 grams of filcoat. Muriate of potash was added at the rate of 50 pounds per an acre, or 6.5 grams per 450 grams of filcoat, and ammonium nitrate was applied at the rate of 150 pounds per acre, or 19.6 grams for 450 grams of filcoat.

After adding each of the respective additives to the filcoat, enough water was added to give the desired consistency for forming the pellets. Each of the additives, when added to the filcoat, furnished enough material to make 400 pellets, weighing 1 gram each and measuring $\frac{1}{2}$ inch in diameter.

The pellets were formed by placing the wet material in a caulking gun and forcing it out along a metal strip which had been previously marked off in $\frac{1}{2}$ inch spaces. The pelleting material was cut at every $\frac{1}{2}$ inch mark, making a pellet cylindrical in shape and $\frac{1}{2}$ inch in diameter.

From all the treatments containing 400 pellets each, 16 divisions were made making 16 samples of 25 each. Four of the samples of 25 were used as the four replicates for each of the species tested. A single seed was pressed into each pellet, and then the pellet was rolled into a spherical form. The pelleted seed were allowed to dry two weeks before planting in the greenhouse.

Two separate tests were conducted using the same process for preparation of the pellets, and the same seed source. The first test was planted on August 25, 1952, and the final count was made on September 27, 1952. The second test was planted on October 7, 1952, and the final count was made on November 10, 1952.

Greenhouse Tests

The pelleted seeds were planted in a sandy loam soil which had been previously screened and fumigated with methyl bromide. The pellets were planted $\frac{1}{4}$ inch beneath the surface of the soil, and a thin layer of sand was spread across the top to prevent drying out. Water was added using a fine sprinkler, and often enough to prevent drying out of the soil and pellets.

The planting was made in a randomized block design, and the "F" test was applied as given by Snedecor.[1] The replications for each treatment were placed at random in the flats. The flats were arranged on greenhouse benches, so that each would receive the same amount of light and air.

Germinator Tests

Germination tests were made on the four species of grass, using germination procedures as recommended in the Proceedings of The Association of Official Seed Analysts.[2]

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[1] Statistical Methods, (Ames, Iowa, 1950) P. 214.

[2] Proceedings of The Association of Official Seed Analysts. (Geneva, N. Y., 1947)

Four replications of 100 seeds each were tested in a Manglesdorf germinator using alternating temperatures of 15°C and 35°C for sand lovegrass, 20°C and 30°C for sand bluestem, and smooth brome, and 15°C and 30°C for switchgrass. Counts were made every other day between the first and last count.

RESULTS AND DISCUSSION

Sand Bluestem

The effect of certain additives on the number of normal seedlings emerging showed a highly significant difference between treatments (Table 1). In the first test conducted, none of the 4 replications of ammonium nitrate treated pellets showed any seedling emergence (Table 5). The average germination of the two tests for sand bluestem pelleted seed treated with ammonium nitrate was 10.0% as compared to 40.0% for those used as a check. The check showed a higher average germination than did any of the treatments. The result of this test would indicate the possibility of ammonium nitrate being toxic to pelleted sand bluestem seed. The period of time between the first and last count on sand bluestem pelleted seed emergence was comparable to the time allowed for seed germination in the germinator as recommended by the Proceedings of the Association of Official Seed Analysts.[1]

Sand Lovegrass

Tests in the green house on pelleted sand lovegrass seed showed no significance between the different treatments to which they were subjected. (Table 2). Apparently no delay was caused in the germination and emergence of pelleted sand lovegrass seed by any of the treatments. Total emergence of plants from the first test with arasan treated pellets

[1]*Proceedings of the Association of Official Seed Analysts*, (Geneva, N. Y., 1950), 21.

Table 1.— The Average effect of 6 additives on the germination and emergence of pelleted sand bluestem seed.

Greenhouse Tests

Additives	Seedling Counts		
	1st test	2nd test	
Check	10.3	10.0	
Arasan	7.8	8.6	
Superphosphate	5.3	9.0	
Ammonium nitrate	0.0	5.0	
5-10-5 fertilizer	4.5	7.0	
Potash	2.5	8.8	
Systox	4.4	7.8	
F Value			12.29**

** The F value exceeds the value required for significance at the 1% level.

In analyzing the data in table 6 a transformation was made by adding 0.5 to the count and extracting the root.[1] This transformation makes the assumptions underlying the analysis of variance of data of this kind valid.

[1]G. W. Snedecor, Statistical Methods, (Ames, Iowa, 1946), 315.

Table 2.— The average effect of 6 additives on the germination and emergence of pelleted sand lovegrass seed.

Greenhouse Tests

Additives	Seedling Counts	
	1st test	2nd test
Check	5.0	4.5
Arasan	7.5	0.5
Superphosphate	5.0	7.0
Ammonium nitrate	3.8	4.5
5-10-5 fertilizer	4.3	4.8
Potash	4.5	5.5
Systox	8.0	3.3
F Value		1.24

In analyzing the data in Table 7 a transformation was made by adding 0.5 to the count and extracting the root.[1] This transformation makes the assumptions underlying the analysis of variance of data of this kind valid.

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[1] G. W. Snedecor, Statistical Methods, (Ames, Iowa, 1946), 315.

was small in all four replications. The four replications of arasan treated pellets in the first test gave counts of 1, 0, 0, 1 plants emerging (Table 6). The average of the two tests showed systox treated pellets giving the highest number of plants emerging, as compared to arasan and ammonium nitrate having the lowest counts. The results of this test would indicate that arasan and ammonium nitrate may have some detrimental effect on the germination and emergence of pelleted sand lovegrass seed.

Smooth Brome

Smooth brome grass tests in the greenhouse showed a significance at the 1% level between the various treatments on total emergence. In both tests pelleted seed to which no additive was incorporated gave the lowest count in number of plants emerging. Brome grass pelleted seed to which Potash was added gave the highest number of plants emerging (Table 3). Potash treated pellets gave a count of 58% seedling emergence, as compared to 38.4% emergence for pelleted seed to which no additive was combined. Results of the test would show that systox has a trend towards retardation on the germination of pelleted brome grass seed.

The inconsistency in effect of each treatment on germination in the greenhouse as compared with germination of seed in the germinator is noticeable. Pelleted seed planted in the greenhouse gave higher germination counts for all treatments, as compared to seed germination in the germinator. (Table 5).

Switchgrass

There was no significant difference between treatments in tests made on pelleted switchgrass seed (Table 4). Systox treated pellets gave

Table 3.— The average effect of 6 additives on the germination and emergence of pelleted smooth brome grass seed.

Greenhouse Tests

Additives	Seedling Counts	
	1st test	2nd test
Check	9.3	10.0
Arasan	12.3	13.8
Superphosphate	15.0	12.5
Ammonium nitrate	11.8	13.0
5-10-5 fertilizer	13.5	12.8
Potash	14.3	15.0
Systox	11.3	15.0
F Value		3.58**

** The F value exceeds the value required for significance at the 1% level.

In analyzing the data in Table 8 a transformation was made by adding 0.5 to the count and extracting the root.[1] This transformation makes the assumptions underlying the analysis of variance of data of this kind valid.

[1] G. W. Snedecor, Statistical Methods, (Ames, Iowa, 1946), 315.

Table 4.— The average effect of 6 additives on the germination and emergence of pelleted switchgrass seed.

Greenhouse Tests

Additives	Seedling Counts	
	1st test	2nd test
Check	6.0	4.0
Arasan	5.3	3.5
Superphosphate	3.5	9.5
Ammonium nitrate	2.5	6.3
5-10-5 fertilizer	2.0	3.5
Potash	5.0	6.8
Systox	8.0	6.3
F Value		2.54**

** The F value exceeds the value required for significance at the 5% level.

In analyzing the data in table 9 a transformation was made by adding 0.5 to the count and extracting the root.[1] This transformation makes the assumptions underlying the analysis of variance of data of this kind valid.

[1] G. W. Snedecor, Statistical Methods, (Ames, Iowa, 1946), 315.

the highest percentage in number of plants emerging, with a germination of 28.5%. Switchgrass pelleted seed treated with 5-10-5 fertilizer gave the lowest number of plants emerging with a germination of 11%. The complete fertilizer (5-10-5) consistently gave the lowest percentage of plants emerging in both tests. None of the treatments had a retarding effect on the emergence of pelleted switchgrass seed.

Conclusion

The percent of germination and plant emergence of the four species of grass tested ran relatively low in both the germinator and greenhouse. Low germination counts in the greenhouse could be partially attributed to the need for keeping the flats moist to prevent drying out of pellets; hence the available supply of oxygen necessary for good germination may be reduced. Any difference in the germination of pelleted seed in the greenhouse and unpelleted seed in the germinator may be due in part to difficulties in maintaining uniform temperatures and moisture conditions in the greenhouse, as well as the effect of the various treatments on the pelleted seed.

The results of this experiment would not indicate a positive relation in favor of pelleting of grass seed for higher germination and better stands. Results were not consistent enough using a standard rate of application of additives to the four species of pelleted grass tested. Unless other rates of application will produce greater increases in germination and emergence of pelleted grass seed of species used in this test, the use of pelleted grass seed cannot generally be recommended.

Table 5.—— Germination Counts of 4 replicates of 100 seed each, for four species of grass.

Germinator Tests

Grass Species	Replication	Seedling Count
Smooth Brome	1	10
	2	10
	3	4
	4	9
Sand Bluestem	1	68
	2	54
	3	66
	4	69
Sand Lovegrass	1	36
	2	44
	3	40
	4	45
Switchgrass	1	25
	2	35
	3	19
	4	36

SUMMARY

Studies were conducted at Stillwater, Oklahoma in 1951 and 1952 to determine the effect of certain additives on the germination and emergence of four species of pelleted grass seed. These species included smooth brome grass, sand bluestem, sand lovegrass and switchgrass. The additives incorporated into the pelleting material were arasan, superphosphate, ammonium nitrate, 5-10-5 fertilizer, potash and systox. These were added at rates generally recommended under ordinary seeding conditions for grasses used in this test. Four replications of pelleted seed to which no additive was incorporated were used as a check for each of the species tested. Tests were made in a Manglesdorf germinator and in the greenhouse. The variously treated pelleted seed were planted in a randomized block, with four replications of 25 each for each treatment.

Ammonium nitrate as an additive to pelleted sand bluestem seed gave inconsistent and seemingly toxic effects. The pelleted sand bluestem seed to which no additive was incorporated gave the highest percentage in the number of plants emerging.

Tests on smooth brome grass pelleted seed showed a highly significant difference between certain additives. Pelleted smooth brome seed without an additive, used as a check, gave the lowest number of plants emerging. Potash, when used as an additive, gave the highest percentage of germination for smooth brome. Apparently none of the additives were

harmful to pelleted smooth brome grass seed; although systox seemed to have a retarding effect on emergence.

The percentage of germination and emergence of pelleted switchgrass seed showed no difference among the various additives used in the test. Systox treated pellets gave the highest percentage in number of plants emerging.

Tests in the greenhouse on pelleted sand lovegrass seed showed no significance between the different treatments to which they were subjected. Apparently no delay was caused in germination of pelleted sand lovegrass seed by any of the treatments. The results of these tests indicate the possibility of arasan and ammonium nitrate having some detrimental effect on pelleted sand lovegrass seed.

Results were not consistent using a standard rate of application of additives to the four species of pelleted grass seed tested. The pelleting of grass seed, with additives incorporated cannot generally be recommended, unless other rates of application will produce greater increases in germination and emergence of pelleted grass seed.

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APPENDIX

Table 6.— The Effect of 6 additives on the germination and emergence per replication of 25 pelleted sand bluestem seed.

Greenhouse Tests

Additives	Replication	Seedling Counts 1st Test	Seedling Counts 2nd Test
Check	1	12	7
	2	12	11
	3	9	13
	4	8	9
Arasan	1	8	6
	2	6	14
	3	10	5
	4	7	10
Superphosphate	1	5	5
	2	7	5
	3	4	13
	4	5	13
Ammonium nitrate	1	0	7
	2	0	6
	3	0	3
	4	0	4
5-10-5 fertilizer	1	7	5
	2	4	6
	3	5	7
	4	2	10
Potash	1	2	11
	2	3	13
	3	3	6
	4	2	5
Systox	1	5	6
	2	7	6
	3	5	9
	4	5	10

Table 7.-- The effect of 6 additives on the germination and emergence per replication of 25 pelleted sand lovegrass seed.

Greenhouse Tests

Additives	Replications	Seedling Counts 1st Test	2nd Test
Check	1	5	3
	2	4	1
	3	6	10
	4	5	4
Arasan	1	7	1
	2	7	0
	3	8	0
	4	8	1
Superphosphate	1	4	6
	2	4	6
	3	4	10
	4	8	6
Ammonium nitrate	1	5	1
	2	2	5
	3	2	6
	4	6	6
5-10-5 fertilizer	1	3	6
	2	7	2
	3	3	5
	4	4	6
Potash	1	1	4
	2	4	8
	3	9	3
	4	4	7
Systox	1	10	4
	2	7	0
	3	9	5
	4	6	4

Table 8.— The effect of 6 additives on the germination and emergence per replication of 25 pelleted brome grass seed.

Greenhouse Tests

Additives	Replications	Seedling Counts 1st Test	2nd Test
Check	1	14	9
	2	11	11
	3	8	7
	4	7	10
Arasan	1	13	14
	2	12	10
	3	16	10
	4	14	15
Superphosphate	1	14	14
	2	10	17
	3	11	12
	4	15	17
Ammonium nitrate	1	17	10
	2	13	14
	3	9	12
	4	13	11
5-10-5 fertilizer	1	13	12
	2	11	14
	3	9	14
	4	18	14
Potash	1	14	13
	2	15	12
	3	15	20
	4	16	12
Systox	1	16	9
	2	16	15
	3	15	10
	4	13	11

Table 9.— The effect of 6 additives on the germination and emergence per replication of 25 pelleted switchgrass seed.

Greenhouse Tests

Additives	Replication	Seedling Counts 1st Test	Seedling Counts 2nd Test
Check	1	3	2
	2	8	5
	3	3	3
	4	10	6
Arasan	1	7	4
	2	6	3
	3	4	2
	4	4	5
Superphosphate	1	8	10
	2	2	9
	3	3	8
	4	1	11
Ammonium nitrate	1	1	6
	2	1	3
	3	2	10
	4	6	6
5-10-5 fertilizer	1	2	4
	2	2	3
	3	3	7
	4	1	0
Potash	1	6	7
	2	3	7
	3	5	8
	4	6	5
Systox	1	3	6
	2	14	3
	3	10	6
	4	5	10

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The content and form have been checked and approved by the author and thesis adviser. The Graduate School office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

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