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The Germination of Frosted Grain

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The Germination of Frosted Grain.

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DEPARTMENT OF

Forestry, Horticulture and Botany.

CHAS. A. KEFFER, Superintendent.

The Germination of Frosted Grain.

A number of letters have been received requesting information on the value of frosted and stack burned grain for seed. There is submitted herewith a tabulated statement of the results of tests of eighteen samples of grain, including two samples of barley, one of oats, and fifteen of wheat.

Different methods for determining the percentage of germination were employed. Fifty seeds of each sample were drilled in black soil, in shallow boxes, which were then placed in the propagating house, where they would have a gentle bottom heat. The soil used was taken from a field that had never been manured.

A number of samples, as shown by the table, were placed in carpet paper cells, the paper is thick and porous, and retains moisture well, thus inducing germination. Still other samples were placed on small squares of carpet paper in flower pot saucers, and these were saturated with water and set one on top of another, thus having an air space of an inch over each sample.

The temperature during the first twelve tests, which were conducted together, was recorded three times a day, as shown in the table. about the same temperature was maintained during the later tests.

The following notes will indicate the condition of the samples named; 100 seeds of each sample, selected at random, were examined:

NO. OF SAMPLE AND KIND OF GRAIN.	PLUMP.	SLIGHTLY SHRIVELED.	MUCH SHRIVELED.	COLOR.
No. 1, Fife wheat	17	33	50	Normal.
No. 2, Fife wheat	8	13	79	Many light col'd grains.
No. 3, Fife wheat	7	15	78	Normal.
No. 4, Fife wheat	40	28	32	6 green seed, a few light.
No. 5, Fife wheat	13	12	75	Light colored.
No. 6, Fife wheat	6	8	86	Light colored.
No. 7, Fife wheat	31	12	47	Normal.
No. 8, Fife and Blue stem	13	16	71	A few light.
No, 9, stack burned Fife	83	10	7	Dark Brown.
No, 10, Fife wheat	21	12	67	Normal.
No. 12, (No. 1 Hard) Fife	84	11	5	Normal.
No. 13. Fife wheat	68	13	29	Normal.

A comparison of the above table, with the figures showing the percentage of germination, will show that seeds do not germinate in the ratio of their plumpness. Of sample No. 4, containing 40 per cent of plump seeds, only 54 per cent germinated, while of sample No. 3, containing but 7 per cent of plump seeds, 82 per cent germinated. In the latter sample by far the greater proportion of the grains—75 per cent were badly shriveled, while in sample No. 4, but 32 per cent were badly shriveled.

A careful microscopic study of the seed wheat, made on grains in every stage of germination—from the time the plumule is just bursting through the seed coat, to the stage in which the young shoot is one inch long, using plants from badly shriveled seed and from seed of the best sample, so that any difference in structure might be apparent, was made during the progress of the test.

As is well known a well matured grain of wheat consists of the germ, and a supply of organized plant-food, consisting principally of starch, which is to sustain the germ, or plantlet, until it shall develop roots and leaves. In perfectly matured seed the grain is plump. But a very small proportion of it is occupied by the germ, by far the greater part being plant-food. The germ consists of a tiny bud at the top of an extremely short stem, to which also is attached a larger, leaf-like body placed in close contact with the food-supply. Under proper conditions of heat and moisture, the germ begins to grow. The first act in growth is the absorption, by the leaf-like body, of food from the supply stored in the seed. Nourished by this food, the tiny bud begins to develop, and from the opposite end of the short stem, roots are cast. As soon as the first leaf shows above ground it is seen to be of a bright green color. By the the time the leaf appears the roots are several inches long, and have already developed along their sides minute hairs, which are no sooner formed than they begin to absorb moisture from the soil—moisture which contains all the nourishment that the plant needs, save what it secures from the air through its leaves. The food-laden moisture absorbed by the roots rises in the young plant to the leaves, where it is digested, and is then available for growth, exactly as is the nourishment stored in the seed.

These, roughly stated, are the stages of germination and early growth.

Two things are necessary in the seed: a germ, and sufficient nutriment to nourish it until, in growth, it can develop roots and leaves. It is apparent that if the germ be injured, no matter what the food supply, or how plump the grain, it will not produce a good plant, and if the germ be killed no plant can grow from it. The germ is so placed in the seed, however, that the food supply protects it measurably and hence is the more liable to injury.

The well matured wheat seed contains much more nourishment than is just sufficient to bring its first leaves above ground under ordinary conditions, and it is very probable that the young plant continues to draw a portion of its food supply from the store in the seed; just how long the dependence of the plant on the seed continues is not known, but there is no reason why it should not make use of the food in the seed until it is entirely exhausted.

Two very important points are suggested in this connection. A liberal supply of nourishment, such as exists in well matured plump grains, enables the germ to reach the surface when the seed is planted much deeper than it should be, or when, from any cause, its growth is mpeded. It often happens, too, that seeds germinate but in their early growth the plants are hampered by bad weather; at such a time a good supply of food within the seed will enable it to exist, tho' its roots and leaves may be useless for the time being. Herein is the great importance of using the very best seed obtainable.

The microscopic examination showed, in many shriveled grains, not an injured germ. Grains in which the germ had but barely broken the covering, and through all lengths up to one inch, were examined, and in all the germs were in a normal healthy condition, so far as could be detected by the microscope. A careful examination failed to show any difference in the starch contained in the shriveled seed, and that in the plump, mature seed, save as to quantity. Here a very important difference was observable.

By cutting open a dry shriveled grain, it is frequently found that the "flour" does not entirely fill the cover, or bran. And just in proportion as this "bran" is filled, or as the grain is plump, so is the food-supply great or small. From what has been said, the importance of using well filled grains for seed is apparent.

Many grains were examined, in which growth had begun, that seemed not more than half filled—a full grain meaning one that is plump—but the germ itself was in quite as good condition in these shriveled grains, as in well matured ones.

The question then becomes simply: To what extent can the stored food in the seed be reduced, and yet support the germ until roots and leaves are formed.

To test this, fifty badly shriveled seeds were taken from each of samples Nos. one, three and six. They were planted one half inch deep, and placed beside the boxes containing the samples noted in the table. The seeds were sown Jan. 19th, and to-day, Feb. 2nd, 34 plants have grown from sample No. 1, 27 from No. 3, and 32 from No. 6. As will be seen by the table, 50 seeds of the entire samples above noted, produced from No. 1, 31 plants, from No. 3, 41 plants and from No. 6, 32 plants.

The plants from the shriveled seeds are now from three to six inches high, averaging five inches; their roots are as well developed as the roots of plants from mature seeds, and their foliage is healthy.

Careful observations have been made on the growth of the first twelve samples named in the table. No difference in strength of growth or healthfulness of foliage has been seen, all have done equally well. On the fifteenth of January the plants were cut off two inches from the ground. On the twenty-first of the month stooling began, and they are now (Feb. 2nd) well stooled. No difference in the time or degree of stooling was apparent in the twelve samples under observation. In a number of specimens examined Feb. 2nd, the food supply in the seed was found to be completely exhausted.

It would not be safe to lay down any arbitrary rule for the use of frosted grain for seed.

Neither would it be fair to conclude, from these experiments, that all seeds in which the germ is uninjured will produce good plants, however shriveled the grains may be. On the contrary, the investigation suggests unusual care in the preparation of the soil and in seeding.

If careful testing shows that a fair percentage of injured grains will germinate, the planter should not conclude that mere germination insures a good crop. Granted that the germ is uninjured (and this is determined when the seeds grow) the plump grain must be taken as the perfect seed, because it is completely filled with plant food, and the seed is good in proportion to its plumpness. Much can be done to aid the growth of shriveled grain; careful preparation of the soil, and planting when the weather is most favorable, are points largely within the control of every farmer. May it not be, also, that with good weather and well prepared soil, comparatively shallow seeding will be advisable?

The table subjoined, it is believed, is self-explanatory. It will be advantageous to compare the result of the difficult samples with No. 12, that being the best that could be secured.

The samples were numbered for convenience in recording as follows:

No.	1	from	H. C. Barringer,	Hannaford.
“	2	“	G. A. Haestad,	Hillsboro.
“	3	“	V. M. Kinney,	Larimore.
“	4	“	F. C. Flagg,	Sykeston.
“	5	“	Walter Muir,	Hunter.
“	6	“	E. J. McInnis,	Hillsboro.
“	7	“	John McCulloch,	Cooperstown.
“	8	“	Wm. McLean,	Bathgate.
“	9	“	F. E. Lally,	Estelline, (Stack-burned.)
“	10	“	L. J. Deacon,	Dawson.
“	11	“	“ “	“
“	12	“	Elevator,	Brookings, (No. 1 hard, $1.10 bu.)
“	13	“	S. F. Bakeman,	Park River.
“	14*	“	D. D. Garvey,	Starkweather.
“	15*	“	“ “	“
“	19†	“	“ “	“
“	17	,,	“ “	“
“	18	“	T. S. Sunderland,	Silvesta.

* Nos. 14 and 15 are barley.

† No. 16 is oats. The remaining samples are wheat.

	NUMBER OF SEEDS GERMINATED IN EACH SAMPLE.																																				TEMPERATURE IN PLANT HOUSE.					
No. of Sample.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.		17.		18.		6 a. m.		12 m.		6 p. m.	
DATE.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	In Soil.	In Paper.	Air.	Soil.	Air.	Soil.	Air.	Soil.
December 27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*	...	...	...	...	...	...	...													56	55	73	60	70	63
" 28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...													53	52	80	75	54	61
" 29	...	15	...	14	...	...	1	37	...	8	...	24	...	20	...	30	...	3	...	13	..	30	...	...													62	59	80	75	58	58
" 30	...	33	17	25	12	26	13	37	7	20	1	33	18	39	17	25	13	4	24	29	5	40	...	37													58	56	75	70	58	63
" 31	16	39	31	29	30	27	17	37	21	30	19	36	27	44	26	29	24	8	36	35	12	40	..	47													57	56	67	64	65	60
January 1	27	41	33	33	40	34	23	40	33	37	28	38	31	43	26	33	28	13	40	38	16	40	30	49													65	63	75	75	65	60
" 2	29	43	34	35	41	35	27	40	34	37	30	38	32	43	26	35	31	13	42	39	21	40	41	49													57	54	81	70	88	62
" 3	29	43	34	36	41	37	27	41	37	39	30	40	37	45	28	36	33	14	43	39	26	40	41	49													61	61	85	78	60	65
" 4	29	44	34	36	41	37	27	41	37	39	30	40	39	45	28	36	33	15	43	41	26	40	41	49													62	62	75	70	62	64
" 5	30	44	34	36	41	37	27	41	37	39	30	45	39	45	28	36	33	15	43	41	26	40	41	49													64	66	62	63	60	61
" 6	31	44	39	37	41	37	27	41	37	40	32	45	42	45	28	36	34	15	43	42	26	40	41	49													60	60	72	72	61	61
" 7	31	44	39	37	41	39	27	41	37	40	32	45	42	45	28	36	34	15	43	42	26	40	41	49													62	64	62	63	65	60
" 8	31	44	39	37	41	44	27	41	37	40	32	45	42	47	28	36	34	15	43	42	26	40	41	49													55	58	75	70	56	53
																												In Saucer.		In Saucer.		In Saucer.		In Saucer.		In Saucer.						
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January 19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	†	..	..	..	..	..	..	..	..	..	..						
" 20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..						
" 21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	63	†	†	†	†	†	†	†	†	†	†						
" 22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	78	..	..	..	..	..	..	..	..	..	..						
" 23	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	88	..	3	..	1	..	..	..	24	..	16						
" 24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	94	..	5	..	2	..	5	..	33	..	25						
" 25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	†	95	..	10	..	10	..	34	..	40	..	31						
" 26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	96	..	14	..	13	..	42	..	40	..	42						
" 27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	..	17	20	45	34	41	27	44						
" 28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	19	7	24	29	46	36	41	30	45						
" 29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	19	9	25	41	47	39	41	38	46						
" 30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	10	..	2	21	12	27	46	47	40	41	41	46						
" 31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	..	3	21	13	27	46	47	42	42	42	48						
Feb'y 1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	29	..	7	21	15	27	47	47	42	42	43	48						
" 2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	40	..	10	23	16	28	47	47	42	42	45	48						
" 3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	44	..	10	23	16	28	47	47	43	42	45	48						
Per ct. germ'd.	64	88	78	74	82	88	54	82	74	80	64	90	84	94	56	72	34	30	86	84	52	80	82	99	88	96	20	43	32	56	94	94	86	84	90	96						

* 100 Seeds.

† Planted.

‡ No. 1 Barley.

¶ No. 2 Barley.

₰ Oats.