THE EFFECT OF ARTIFICAL DRYING OF FIELD CORN IN DIFFERENT STAGES OF MATURITY ON THE VITALITY OF THE SEED

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Arthur Russell Marston

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THESIS

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A Thesis Prepared by ARTHUR RUSSELL MARSTON in Partial Fulfillment of the Requirements for the Degree of Master of Science, Department of Farm Crops.

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INTRODUCTION

Field corn is one of the important crops to Michigan farmers. Each year its yield is equivalent to approximately 66,796,000 bushels. An important question in corn growing arises, however, - Is it possible for every farmer in Michigan to grow the seed corn that he plants?

We immediately answer "yes", but the quality of that seed corn cannot be guaranteed to be of high vitality in every case. If weather conditions for all years were the same, and we had the choosing of that particular kind of a year, I feel sure we would choose a year in which no frosts were earlier than November, with as little rainfall as was necessary. As we are handicapped in this respect, we naturally have to take what is given us and plan to meet whatever conditions may prevail. We must admit that in years of high precipitation, cool weather and early frosts, we do not have the corn maturing and drying on the stalk fast enough for us to select seed that would be high in vitality. Would it be possible for us to select our seed in an earlier stage of maturity--for example, in the milk or soft dough--and, by some drying process, evaporate off the excess moisture and store it in conditions where that moisture could be kept as constant as possible and, in this way, obtain seed corn of high vitality and able to produce a yield equal to that of seed corn that was left to mature and dry on the stalk?

The object of the investigations in this thesis has

been to determine the effect of artificial drying of field corn harvested in different stages of maturity on the vitality of seed.

REVIEW OF LITERATURE

1. Stages of Maturity

Kidd, F and West, C (1) state that the most obvious categories under which we may deal with conditions affecting the potentiality of the seed, measuring by this the capacity of the resulting plant growth and yield are as follows--(1) Parental conditions, (2) Harvesting conditions, (3) Conditions during or immediately preceeding germination or in the early stages of the seedling. A consideration of the results reviewed above makes it clear that the question as to whether differences in the resulting plant are predetermined by the use of seeds differing in degree of ripeness cannot be regarded as satisfactorily answered in the case of any single species. This is due to the fact that all the recorded comparisons between plants grown from immature seeds and plants grown from mature seeds appear to have been complicated by some period of storage. Immature seeds are less tolerant of storage in the dry condition than mature seeds so that in comparisons which have been made the total yields from immature seeds are usually less than those from mature seeds owing to the fact that a small percentage of the immature seed germinate. From the point of view of the grower, seed harvested at a stage somewhat previous to maturity may, under certain conditions give a better yield than seed allowed to become dead-ripe upon the parent plant, but it must be borne in mind that immature seed does not with-

stand storage as well as seed which has been allowed to become fully ripe.

Dungon D. H. (2) states seed corn harvested before complete maturity absorbed water more rapidly and also possessed a greater water absorptive capacity than corn that had been allowed to mature on the stalk. Although early harvested seed corn absorbs water more rapidly than corn that is allowed to mature on the stalk, the mature corn is distinctly the better from the standpoint of seedling vigor.

The corn harvested in the milk stage began germinating earlier than that harvested in the dent stage. The dent stage likewise produced a higher percentage germination during the first three days than the corn gathered after it had become mature. Soon, however, the "milk stage" seed showed evidence of lack of vigor. The corn in the 30°C chamber particularly that harvested at the milk stage was soon overrun by molds and for that reason the germ emergence was abnormal. (Phisopus sp, Penicillium sp, and Aspergillus sp.) Hughes H. D. and Stanfield W. W. (3).

1. The more immature seed corn picked at weekly intervals and cured and stored in the seed house with articicial hear gave 65% strong ears, the closed shed 14% and the open shed 10%. Several of the early selections showed practically perfect germination when stored in the seed house and cured with artificial heat.

Hughes H. D. (4) states

Those ears which produced the most rapid growth when planted in the field have uniformly given the most satisfactory yields.

Arny A.C. (5)

Correlation between weight of seed sown and resultant plant characters at maturity is not high in any instance and may be so modified by enviroment conditions that the relation may be slight or obliterated entirely.

Crocker, William & Harrington, George T.(6)

The catalase activity of the grains of grasses is determined to a large degree by their maturity at the time of harvest. The immature grains have much higher activity than mature ones. Test with Sudan grass showed that the higher activity of immature grains is not lost with thorough drying, but it is maintained after years of dry storage.

2. Artificial Drying

Hughes H. D. and Stanfield W. W. (3)

The mature ears of corn picked at weekly intervals throughout the fall and stored in seed houses with continuous heat 74% gave strong germination, the same quantity of ears picked at the same time but stored in a closed shed with no artificial heat gave 35%, while that stored in an open shed showed only 11% of strong ears. In many cases, however, it is well worth while to provide some artificial heat. This is practically true with corn which contains considerable moisture when picked.

Kienhol (5) finds in an elaborate study of the effect of high temperatures on seed corn that air dry corn was killed by exposure to 80°C for 25 minutes and to 90°C for 10 minutes and injured by exposure to 70°C, 80°C, 90°C for 80, 10 and 5 minutes respectively. Resistance to heat waned inversely as to water content.

Ewart A. J. (8) in working with seeds of wheat, corn, barley, peas, artichokes, hemp, squash, rape and sunflower which he dried in a vacuum desiccator at 37° to 30°C concluded that it was impossible to reduce the % water held by even the most resistant seeds to lower than 2% or 3% of their dry weight without affecting their vitality. Ewarts hypothesis was that excessive drying so changed the dormant protoplasm that upon being remoistened it was unable to re-establish the molecular groupings essential for normal vital activity.

Harrington G. T. & Crocker William (6) in an essay describing experiments to determine the effect on the vitality of certain seeds when dried under varying conditions and for varying lengths of time, it was found that the percentage of germination was not materially changed when seed of wheat, barley, Sudan grass, Kentucky bluegrass and Johnson grass was dried to less than 1% moisture. The percentages of germination of Kentucky bluegrass and Johnson grass was not affected when the moisture was further reduced to .1% although the vigor of the Kentucky bluegrass seed was further dried in a vacuum oven for 6 hours at 100°C, the vigor of the seedling was further reduced, but the percentage of germination was not materially affected.

All this controverts Ewarts (8) statements as to the degree of drying which seeds are capable of withstanding and remaining viable so far as the seeds used in this experiment are concerned.

Waggoner H. D. (9) in a study of radish seeds (Raphonus Sativus L.) as affected by high temperatures says that by drying first at 60°C and later at 100°C reduced the moisture content of radish seeds to 4% without affecting subsequent germination.

Crooker Wm. (10)

The changes involved in rapid loss of vitality by seeds that will not withstand drying are still more obscure. The nature of the injury produced by drying is also entirely unknown.

Montgomery E. G. (11) states experimental work has shown that grain insects exposed to a temperature of 120°F for 15 or 20 minutes will be killed. This temperature also kills the eggs, larvae and pupae.

3. Water Absorption of Seeds and Permeability of Seed Coats

Shull, Charles A. (12)

The main chemical changes with rise of temperature are believed to occur in the colloids of the seed, and semipermeability, as such, is thought not to be an important factor in determining the rate of water absorption. Greater amounts of oxygen absorbed with seed coats removed. Oxygen accelerates germination, Xanthium glabrutum.

Rose D. H. (22)

For two varieties of lettuce it is shown that the seed improves in viability as it grows older, up to the end of at least the fourth year. This improvement is probably due to increased permeability of the inner seed coat to water.

Dixon H. H. (23)

Protoplasmic permeability is greatly increased by rise in temperature. Syringa vulgari and Hedera helix used.

Crocker Wm. and Davis, Wilmer E. (24)

Dormancy in the akenes of alisma Plantago is due to the mechanical restraint of the seed coat. This restraint enables the seed to lie in water for years without germination.

Crocker Wm. (10)

Delayed germination is reported in the seeds of many plants, and exactly opposite to the common view, its cause generally lies in the seed coats rather than in the embryo's; but in hawthornes as perhaps in some other seeds it is due to embryo characters. Seed coats which exclude water are much better adapted to securing delays than are seed coats which exclude oxygen, because of the much greater reduction of respiration in the first case. In nature growth of the delayed seeds comes about through the disintegration of the seed coat structures by a larger or shorter exposure to germination conditions and the length of the delay depends upon the persistence of the structure securing it.

4. Catalase

Crocker William & Harrington, George (5) states that catalase is an enzyme capable of splitting hydrogen peroxide into water and oxygen. It is universally present in living matter and was supposed to be a property of all enzymes until Loew (20) showed it to be a distinct body. There is some question arising as to its real enzymic nature. Its function in the organism is not known.

Catalase activity of seeds seems to parallel physiological behavior much more generally than does oxidase activity.

Appleman, Chas. O. (12)

Catalase is probably the most widely distributed of any of the known enzymes. In fact, its occurence is so general that Loew (20) concluded that there did not exist a group of organisms or any organ or even a single vegetable or animal cell that did not contain some catalase.(11) There is no correlation between oxidase activity and the respiration in these organs (potato). Catalase activity in the potato juice shows a very striking correlation with respiratory activity in the tubers.

Heinke, Arthur John (13)

Treatments tending to increase nitrogen content in many cases cause increase in catalase activity, condition causing increase in carbohydrates seem to produce decrease in catalase activity.

Ne Mec Antonin and Duchon, Frantisck (14)

Catalase activity consistent with viability. Hard coated seeds, like those of trees, difficult to germinate in laboratory.

Crocker, William and Harrington, George T. (6)

On Johnson grass seed there seems to be close correlation between catalase activity and respiration intensity, but not any very close correlation between either of them and vitality of the seed or vigor of the seedling. Catalase activity decreases with age. In amaranthus, no correlation even with respiration. Oxidases as active in non-living as living organs.

McHague, J. S. (15)

Peroxidase reaction may be used for seed testing. Seeds of high, low and medium viability. Vital property of seeds contained in substance (presumably oxyglucose) which has power to activate moleculor oxygen in air, peroxidase being found. This power lost when seed loses power to germinate. Peroxidases also determine rate of loss of viability.

Vant T. Hoff (16)

The Vant Hoff velocity coefficient for potato catalase is 1.5 from 0°C--10°C. At higher ranges of temperature there is an apparent progressive decrease in the velocity coefficient. This is due to actual destruction of the catalase which is not due in the main to impurities in the hydrogen peroxide or to oxidation by the hydrogen peroxide.

Bailey, C. H. (17)

Increasing temperatures accelerate the rate of respiration until 55°C is reached. As the temperature rises the diastatic action upon starch increases. A point is

reached, however, at which the enzyme activity deminishes. At 55°C the whole mass of wheat is of a mahogany color. At 65°C the respiratory enzymes have been partially but not wholly inactivated while at 75°C this inactivation has proceeded still further and some roasting of the grain has occurred.

Appleman, Chas. O. (12)

Catalases from different sources show considerable variation in temperature relations, the point of total destruction in the cases reported ranging from 65°C to 80°C. In potato catalase, however, destruction is complete when the temperature reaches 50°C. At 20°C a destruction of the catalase begins, which renders the accelerating effect of higher temperatures upon the peroxid decomposition, impossible of manifestation.

Crocker, William & Harrington, George T. (6)

Heating air dry seeds causes a fall in their vitality as well as in their catalase activity, but the denaturing of the substances connected with viability and of the catalase do not parallel each other. Heating Johnson grass seed to 81°C from half an hour to two hours reduces the catalase activity by a large percentage and improves the germination. Longer heating 4 hours at 81°C causes considerable additional reduction in the catalase activity and a very decided fall in germination. Still longer heating, 17 hours at 81°C reduces the catalase to from 10 to 16% of its original value and kills all the seeds. Heating to 100°C for 5 hours kills all the seeds and destroys all their catalase. In the early stages

of heat degeneration as in time degeneration the catalase falls faster than the viability, but some catalase activity persists after the seeds are all killed.

Schoenbein (18)

Concluded that the power to decompose hydrogen peroxide (H_2O_2) and to blue gnaiacium thereby is intimately associated with the specific activity of the unorganized ferments and with such vital phenomena as the sprouting of seeds, etc., inasmuch as all of these bioligic properties are lost by heating to 100°C by exposure to H_2S and also as shown in a later paper by exposure to hydrocyanic acid.

Jones, H. A. (19)

After a slight initial increase, catalase activity gradually decreases in the dessiccating seeds. Catalase activity increases enormously during the early stages of germination.

Shull, Chas. A. and Davis, Ward B. (21)

Catalase activity is relatively stable in dry stored seeds for several months.

Fig. No. 1--Showing ears that had been selected in different stages of maturity and a germinated kernel from each. No.1 was selected in the hard dough; No.2 was selected in the soft dough; No.3 was selected in the milk stage.

EXPERIMENTAL METHOD

In the fall of 1924 seed ears of dent corn (zea mays indentata) were harvested in different stages of maturity according to the classification (No.1).

No. 1. Classification for stage of maturity

Milk Stage--When milk exudes by a slight pressure of the finger nail.

Soft Dough Stage--When soft dough, which is rubbery in texture, fills the endosperm and the kernel begins to dent.

Hard Dough Stage--When the endosperm is filled with firm dough and the kernel is fully dented.

A sample of six ears of each was placed on a table in the laboratory at an approximate temperature of 68°F, and allowed to dry out so shelling could be done. At the same time, samples were placed in ovens (Fig. 2) under definite temperatures for different lengths of time. These ovens could be kept at a constant temperature, as they were electrically heated and thermostat controlled. It was necessary to have the temperature quite high in order to successfully free the corn of its excess moisture immediately. Soft dough and milk samples were left in a temperature of 112°F for eighteen hours while hard dough was left in the same temperature for twenty-four hours. The milk stage and soft dough stage were also subjected to a temperature of 95°F for a period of thirty-six hours, which was twice the former period of time.

Germination tests were made in a germinator(Fig.3) after a few months rest period had been given the samples. In the spring of 1925, the residue of all these samples

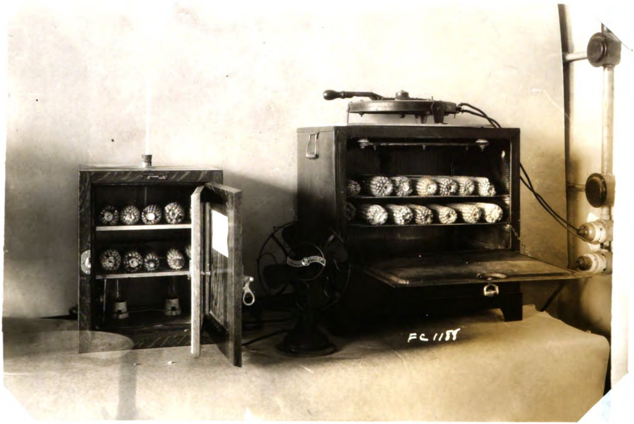

Fig. No. 2--Electric ovens used in drying corn samples. Notice electric fan in middle. This is used to force circulation at the inlet of the ovens.

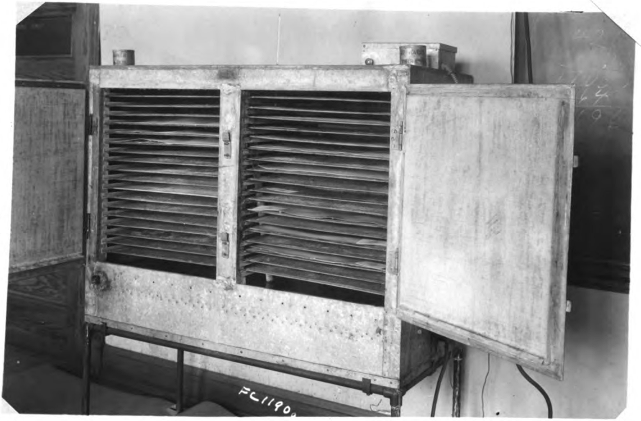

Fig. No. 3--Germinator used in making germination determinations. Kept at a constant temperature of 22°C.

was planted in the field where we could observe our plots in actual operation under field conditions.

The series were planted in triplicate, every fourth plot in each series being a check. In this way soil variation was taken care of as each row was compared to its check which was a standard sample of Duncan seed corn that had been dried by means of natural outdoor air circulation such as would be obtained in any good seed corn drying house without the use of artificial heat.

One-hundred and eighty kernels were planted in each plot and the plants counted when they germinated, thus obtaining a record of the germinability of the seed in the field. All plots were handled and harvested in a like manner. The weight and number of the ears were taken. A sample of ten ears from each plot was stored for the purpose of getting the moisture content and shelling percentage when properly dry. These ten ears were weighed when harvested and re-weighed when shelled for the purpose of obtaining loss in moisture until the test could be made in the moisture tester (Brown Duvel Moisture Tester,Fig. 13).

The yields were calculated by bringing all samples to 14% moisture and P. E. calculated on all samples by Bissell's modified method.

In the fall of 1925, samples of seed corn were again harvested in different stages of maturity according to classification No. 1.

These samples were put thru the same form of ex-

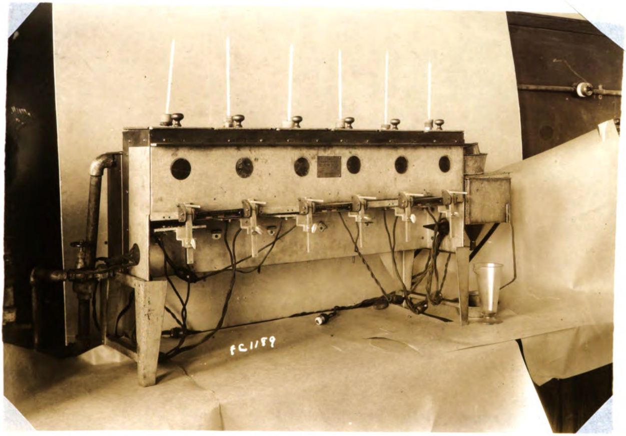

Fig. No. 13--Brown Dureel Moisture Tester used in making moisture determinations.

periment as in the former year, but a greater number of different temperatures were used in the artificial drying. All samples of each stage of maturity were held in temperatures of 90°F, 108°F, 125°F, 144°F, and 161°F for periods of 48 hours, 24 hours and 12 hours. A sample of 10 ears was dried at each time and immediately after they were taken from the ovens, (Fig. 2) a sample of one ear was obtained, a moisture determination being made on the sample by the Brown Duvel Moisture Tester (Fig. 13.)--One ear was kept for observation and two ears of each sample were placed in different storage conditions. These storage conditions were the barn, laboratory, root cellar and greenhouse.

Samples were hung on wire hangers so that there were no ears touching each other. After a period of three months in these varying storage conditions, all samples were brought into the laboratory and hung up together. These were left for a period of one month in order that they might all reach the same degree of moisture percent,--The laboratory being approximately 85°F.

At the end of one month all samples were shelled and a germination test was made by the laboratory germinator (Fig. 3). In making the germination test, two samples of 100 kernels each were taken from each ear. Tests were made of both ears stored because this was necessary in order to eliminate any ear characteristics that might tend to give one ear more potentiality than another. These samples were placed between wet blotters as shown in (Fig. 14) with all the kernels placed in a like manner. All kernels were placed so the embryo end was facing the same direction and the embryo side of the kernel was facing upward(Fig. 14). Due to variations of temperature within the germinator, (Fig. 3) samples of each ear were placed both in the top portion of the germinator and in the bottom portion of the germinator. Control samples were placed on every tray, each sample being of the same variety of corn used in the experiment that had been allowed to mature in the field, and had been stored in a good outside, air circulated, drying house. All samples were left in the germinator for a period of five days.

All samples upon removal from the germinator were counted for the number of viable and non-viable seeds. For a measure of vigor of the young seedlings, actual measurements(Fig. 16) were made of plumule and radical of each seedling. These seedlings were then classified according to classification No. 11.

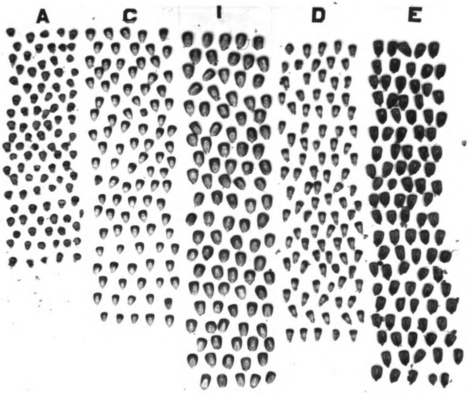

Fig. No. 14--Tray of 100 kernel samples of corn before placing in germinator for germination test. (A) Milk stage heated 24 hours @ 108°F. (C) Hard dough stage heated 12 hours @ 108°F. (I) Control sample (J. R. Duncan's M. A. C. standard variety) (D) Soft dough stage heated for 24 hours @ 108°F. (E) Hard dough stage heated 48 hours @ 161°F.

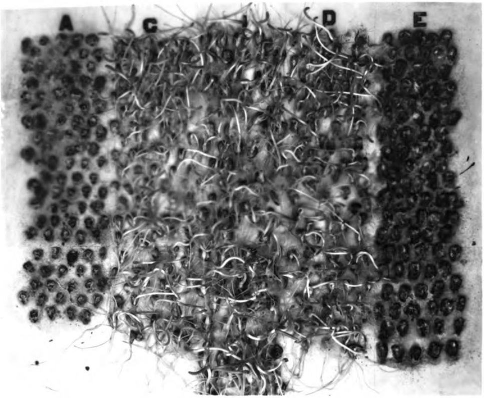

Fig. No. 15--Tray of 100 kernel samples of corn as shown in Fig. after having been placed in germinator (Fig. No.3) for a 5 day period.

No. 11 Classification for seedling vigor.

VV -	Very Vigorous	--Radical over 6 centimeters, Plumule 1 centimeter or over or Plumule over 4 centimeters.
V -	Semi Vigorous	--Radical between 4 and 6 centimeters, Plumule ½ to 1 centimeter, or Plumule 2 to 4 centimeters.
W -	Weak	--Measurements less than above or any seedling that is without either a Plumule or a Radical.
D -	Dead	--No emergence of both Plumule and Radical.

We then assumed that should all kernels be planted of a type similar to the VV class that we could obtain a 100% stand everything else being equal. For class V we could obtain a 90% stand and for class W we could obtain a 50% stand. Therefore, we gave the VV class the value of 100 for vigor, V class 90 for vigor, W class 50 for vigor, and, of course, D class 0 for vigor. We then divided our total vigor by 100 in order to have it per average seedling.

For example, in calculating seedling vigor of a sample of 100 kernels that had been germinated would be as follows:

Classification	Number		Value		Vigor
VV	59	x	100	-	5900
V	22	x	90	-	1980

Classification	Number		Value		Vigor
W	19	X	50	=	950
D	0	X	0		
		Total Vigor			8830

Vigor of average seedling = $\frac{8830}{100}$ = 88.3

Calculations were made in a like manner for control samples and their values compared to the sample being tested by the use of students modified method for calculation of odds.

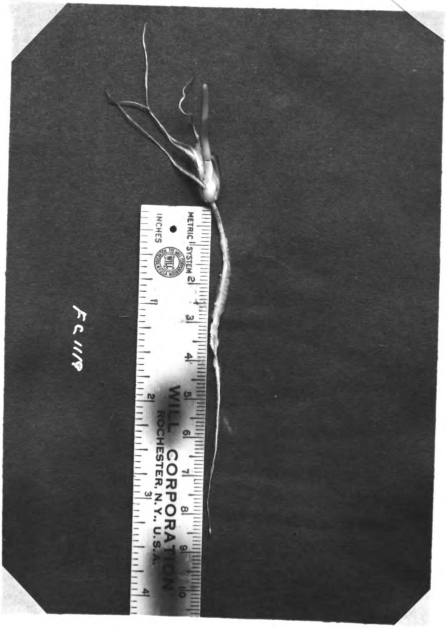

Fig. No. 16--Measuring plumule and radical of germinated kernel after 5 days in the germinator.

W

DISCUSSION OF EXPERIMENTAL DATA

All samples which were harvested in 1924 in the immature stage after drying showed a partially wrinkled appearance, especially in the milk stage. This was evidently due to the evaporation of high percentage of moisture as found in the immature seed at time of harvest. After drying there was a marked difference in the weight of seed in the milk stage and the seed in the hard dough stage. These weights are shown in Table I. All samples also showed a decrease in germinative power when planted in the field compared to the laboratory germination test. This decrease was not consistently increased as the stages of maturity from the hard dough stage to the milk stage. were reached. A greater variation, nevertheless, was found in the germinability of the immature seed than in the mature seed. We do not find, however, direct correlation between the variation in the power to germinate and in the power to yield which results.

Number of Plot	DESCRIPTION OF SEED PLANTED: Stage of Maturity	Temperature for Drying	Weight of ten kernels	Laboratory Germination Per Cent	Field Germination	Corrected Yield at 14 percent-M
2500	Check			100	72	37 Plus or Minus 1.8
2501	Hard Dough	112°F - 24 hours	3½ Grams	100	87-	35 " " " 1.8
2502	" "	112°F - 24 "	3 "	100	89	32 " " " 1.6
2503	" "	112°F - 24 "	3½ "	100	86	31 " " " 1.5
2504	Check			100	88	35 " " " 1.7
2505	Soft Dough	68°F - Lab	3 "	100	71	52 " " " 2.6
2506	" "	95°F - 36 hours	3 "	100	65	27 " " " 1.7
2507	" "	68°F - Lab	3 "	100	76	39 " " " 1.9
2508	Check			100	87	37 " " " 1.8
2509	Milk	95°F - 36 hours	2 "	90	50	24 " " " 1.2
2510	"	112°F - 18 hours	1¾ "	50	23	33 " " " 1.6
2511	"	68°F - Lab	2 "	100	92	57 " " " 1.8
2512	Check			100	95	35 " " " 1.7
2513	Hard Dough	112°F - 24 hours	4 "	100	93	34 " " " 1.7
2514	" "	68°F - Lab	3½ "	100	92	31 " " " 1.5
2515	" "	68°F - Lab	4 "	100	92	39 " " " 1.9
2516	Check			100	90	35 " " " 1.7
2517	Soft Dough	112°F - 18 hours	2½ "	100	46	24 " " " 1.2
2518	" "	68°F - Lab	2½ "	100	92	45 " " " 2.2
2519	" "	68°F - Lab	2½ "	100	85	41 " " " 2.0
2520	Check			100	91	34 " " " 1.6
2521	Milk	68°F - Lab	2 "	100	63	17 " " " .8
2522	"	68°F - Lab	1½ "	100	88	42 " " " 2.1
2523	"	112°F - 18 hours	2 "	30	15	7 " " " .35
2524	Check			100	95	38 " " " 1.9
2525	Hard Dough	68°F - Lab	3½ "	100	87	24 " " " 1.2
2526	" "	68°F - Lab	3½ "	100	91	35 " " " 1.7
2527	" "	68°F - Lab	3½ "	100	97	37 " " " 1.8
2528	Check			100	95	34 " " " 1.6
2529	Soft Dough	68°F - Lab	3 "	100	91	27 " " " 1.3
2530	" "	68°F - Lab	2½ "	100	96	37 " " " 1.8
2531	" "	112°F - 18 hours	2½ "	100	83	33 " " " 1.6
2532	Check			100	98	30 " " " 1.5
2533	Milk	68°F - Lab	2 "	100	88	33 " " " 1.6
2534	"	68°F - Lab	2½ "	100	81	35 " " " 1.7
2535	"	68°F - Lab	2 "	100	54	18 " " " 1.9
2536	Check			100	97	37 " " " 1.8

In comparing samples tabulated in Table II which were taken from the yield series in Table I, we will use the mean yield first. The mean yield was obtained by the use of students' method in averaging two, three or more values.

We find, however, a higher yield for the soft dough than any other stage of maturity. This comparison was calculated by the use of students' method for determining a difference.

1. Soft Dough mean yield	40	plus-minus	.8
Hard Dough mean yield	33.2	"	.7
Difference	6.8	"	1.0
2. Soft Dough mean yield	40	plus-minus	.8
Milk mean yield	33.6	"	.7
Difference	6.4	"	1.0
3. Soft Dough mean yield	40	plus-minus	.8
Check(glazed)mean yield	35.5	"	.6
Difference	4.5	"	1.0

As the difference, in every case, is greater than 3.3 X PE, we, therefore, conclude that we have a significantly higher yielder in the Soft Dough Corn than any other stage of maturity.

TABLE II.

Stages of Maturity	Temperature of Storage	Germination % in Laboratory	Germination % in Field	Yield in Pounds at 14% Moisture
Milk	68°F Lab.	100	92	57 plus-minus 2.8
Milk	68°F Lab.	100	63	17 " .8
Milk	68°F Lab.	100	88	42 " 2.1
Milk	68°F Lab.	100	88	33 " 1.6
Milk	68°F Lab.	100	81	35 " 1.7
Milk	68°F Lab.	100	54	18 " .9
				Mean = 33.6 plus-minus .7
Soft Dough	68°F Lab.	100	71	52 plus-minus 2.6
Soft Dough	68°F Lab.	100	76	39 " 1.9
Soft Dough	68°F Lab.	100	92	45 " 2.2
Soft Dough	68°F Lab.	100	85	41 " 2.0
Soft Dough	68°F Lab.	100	91	27 " 1.3
Soft Dough	68°F Lab.	100	96	37 " 1.8
				Mean - 40 plus-minus .81
Hard Dough	68°F. Lab.	100	92	31 plus-minus 1.5
Hard Dough	68°F. Lab.	100	92	39 " 1.9
Hard Dough	68°F. Lab.	100	87	24 " 1.2
Hard Dough	68°F. Lab.	100	91	35 " 1.7
Hard Dough	68°F. Lab.	100	97	37 " 1.8
				Mean - 33.2 plus-minus .7

TABLE II.
(Continued)

Stages of Maturity	Temperature of Storage	Germination % in Laboratory	Germination % in Field	Yield in Pounds at 14% Moisture		
Check Mature	Outside Seed House	100	72	37	plus-minus	1.8
Check Mature	Outside Seed House	100	88	35	"	1.7
Check Mature	Outside Seed House	100	87	37	"	1.8
Check Mature	Outside Seed House	100	95	35	"	1.7
Check Mature	Outside Seed House	100	90	35	"	1.7
Check Mature	Outside Seed House	100	91	34	"	1.6
			Mean	35.5	"	.6

In comparison of the milk stage mean yields with the hard dough stage and check, we get a somewhat different result.

1.	Milk Stage mean yield	33.6	plus-minus	.7
	Hard Dough Stage mean yield	33.2	"	.7
	Difference	.4	"	.9
2.	Check mean yield	35.5	"	.6
	Milk Stage mean yield	33.6	"	.7
	Difference	1.9	"	.9

As the difference in each case is not as great as 3.3 X P.E. we, therefore, conclude that there is no difference in the yield. We also find the same result when we compare the hard dough stage to the check.

Check (Glazed)	35.5	plus-minus	.6
Hard Dough Stage	33.2	"	.7
Difference	2.4	"	.9

Therefore taking the situation from a mean yield standpoint the soft dough stage of maturity is higher in yield than any other stage in the yield test. We also conclude as far as this experiment is concerned that there is no difference in the mean yield of any of the other stages of maturity; i.e. hard dough, milk, glazed. The question immediately rises, "Was the higher yield of soft dough seed due to the immaturity of the corn?; if so, why was the milk corn not as high i or higher than the soft dough stage?

Taking the resulting yields from individual yield standpoint, we do have individual plots that had been planted to milk

Fig. No. 4--Showing plats in field after corn was above ground 6 inches high. Where the white stake is plot No. 2510 planted with seed that had been harvested in milk stage and artificially dried for 18 hours at 112°F. Plot No. 2509 which is directly to the right is also milk stage seed planted which had been dried for 36 hours at 75°F.

Fig. No. 5--Showing plot No. 2522 with white stake in the distance had been planted to seed that had been harvested in the milk stage and artificially dried for 18 hours at 112oF.

stage seed, yielding considerably higher than any other stage of maturity. Take for example plot No. 2511, Table I, which yielded considerably higher than any other plot in the series, the next highest plot, No. 2518, Table I, yielding 45 plus-minus 2.2.

Plot No. 2511 Milk Stage	57	plus-minus	2.8
Plot No. 2518 Soft Dough Stage	45	"	2.2
Significant Difference	12	"	3.5

Due to the high percentage of moisture in the milk stage, corn seed, it does not withstand storage conditions as well as the more mature corn, Kidd & West (1), which would tend to cause the variability in the power of the seed to yield. Even though it failed to withstand the storage as well as the more mature corn, we received equally as good a yield. The soft dough being lower in percentage moisture was able to withstand storage conditions better than the milk stage seed.

TABLE III.

Results secured with seed corn kiln dried at 112°F as compared to air-dried sample (Duncan standard variety) when planted for yield.

Fig No. 6--Showing plot No. 2517 which had been planted with seed that had been harvested in the soft dough stage and artificially dried for 18 hrs. at 112°F.

Fig. No. 7--Showing plot No. 2513 which had been planted with seed that had been harvested in the hard dough stage and artificially dried for 24 hrs. at 112°F.

Stage of Maturity	Time exposed to Temp.	Germination in Laboratory	Germination in Field	Yield in Lbs. @ 14% Moisture		
Milk	18 hrs.	50	23	33	plus-minus	1.6
Milk	18 "	30	15	7	"	.35
			Mean Yield	20	"	.9
Soft Dough	18 "	100	46	24	"	1.2
Soft Dough	18 "	100	83	33	"	1.6
			Mean Yield	28	"	1.0
Hard Dough	24 "	100	87	35	"	1.8
Hard Dough	24 "	100	89	32	"	1.6
			Mean Yield	33	"	1.2
*Check(Glazed)	Air Dried	100	72	37	"	1.8
*Check(Glazed)	Air Dried	100	88	35	"	1.7
			Mean Yield	36	"	1.2

*Check is the air dried sample of Duncan Corn when planted for yield.

Comparisons in Table III were calculated according to students' methods of comparison and a difference must be at least 3.3 X P.E. in order to be significant.

1.	Check mean yield	36	plus-minus	1.2
	Hard Dough mean yield	33	"	1.2
	Difference	3	"	1.9
2.	Check mean yield	36	"	1.2
	Soft Dough mean yield	28	"	1.0
	Difference (significant)	8	"	1.7
3.	Check mean yield	36	"	1.2
	Milk mean yield	20	"	.9
	Difference (significant)	16	"	1.7

Fig. No. 8--Showing relative amount of corn produced by plots in yield series. On the left plot No. 2512 which was the check(Duncan standard seed) dried without artificial heat yield 35 plus-minus 1.7 pounds. In the center plot No. 2511, seed used to plant was selected in milk stage with no artificial heat used but stored in laboratory yield 57 plus-minus 1.6 pounds. On the right plot No. 2510 seed used to plant was selected in the milk stage and was artificially dried for 18 hours at 112°F, yield 33 plus-minus 1.6 pounds.

We can immediately observe that the immature samples showed a significant decrease in yielding ability from that of the check yield. This shows that they were damaged by that particular drying process. The hard dough stage did not show a significant difference in yielding ability from that of the check, even though it had been exposed to the same temperature as the immature samples for 6 hours longer.

TABLE IV.

Results secured with seed corn kiln dried at 95°F when in immature stage as compared to air dried samples (Duncan standard variety) when planted for yield. Check taken from Table III for comparison.

Stage of Maturity	Time exposed to Temp.	Germination in Laboratory	Germination in Field	Yield in lbs. @ 14% Moisture
Milk	36 Hours	90	50	24 plus-minus 1.2
Soft Dough	36 "	100	65	27 " 1.7

Comparisons in Table IV were calculated according to students' method of comparison and a difference must be at least 3.3 X P.E. in order to be significant.

1.	Check mean yield	36	plus-minus	1.2
	Soft Dough "	27	"	1.7
	Difference(Significant)	9	"	2.0
2.	Check mean yield	36	"	1.2
	Milk " "	24	"	1.2
	Difference(Significant)	12	"	1.9

We can, therefore, conclude again that the immature samples were damaged with this particular drying process even though not to such a great extent as in Table III. Possibly if a greater number of plots had been used in this case we would not have had a significant difference in the soft dough stage.

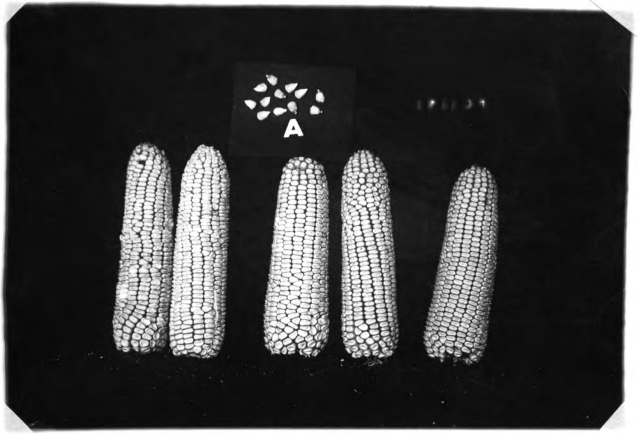

Fig. No. 9--Five ears representing plot No. 2534 in the yield series when planted in the field. The loose kernels are a sample of the milk stage corn that had been planted to produce these ears.

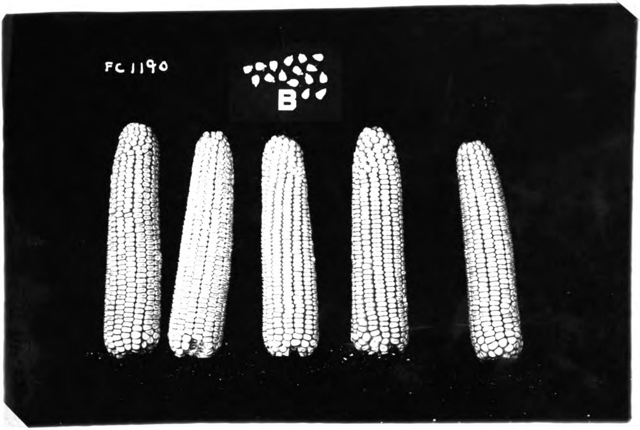

Fig. No. 10--Five ears representing plot No. 2511 in the yield series as type harvested from kernels planted of the milk stage. This was the highest yielding plot in the series. The loose kernels are a sample of the kernels planted to produce these ears.

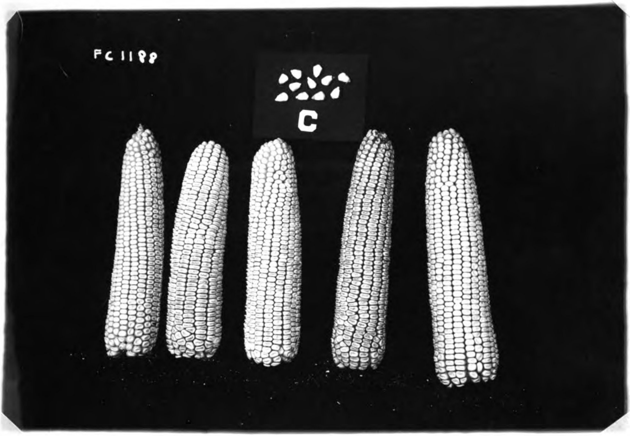

Fig. No. 11--Five ears representing plot No. 2519 in the yield series as type of ear harvested from corn planted from seed that had been harvested in the soft dough stage. Loose kernels is a sample of the seed that had been planted to produce these ears.

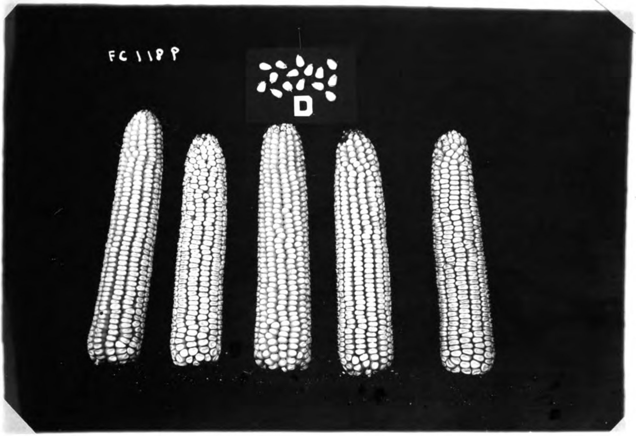

Fig. No. 12--Five ears representing plot No. 2506 in the yield series as type of ears harvested from corn planted with seed that had been harvested in the soft dough stage. Loose kernels are a sample of the seed that had been planted to produce these ears. Was artificially dried for 36 hours at 95°F.

TABLE NO. V.

Corn harvested in milk stage, artificially dried and stored in Laboratory

Date	Treatment	Moisture after Treatment	Germ Sample	Germ Control	Vigor Sample	Vigor Control	Odds
Aug.19	90F. 12 Hrs.	66%	88	99	88	79.2	4.3-1
Aug.19	90F. 24 "	59%	71	99	46.7	90.8	144 -1
Aug.19	90F. 48 "	55%	16	99	11.1	89.6	624 -1

Table No. V shows when corn is harvested in the milk stage and dried with Artificial Heat at a Temperature of 90°F for the periods of 12 hours, 24 hours, and 48 hours. There is a decrease in Germination power and also in Seedling Vigor as the period of time is increased. It is evident that there has been no damage done when the sample is only held for the period of 12 hours by the Odds of 4.3-1, which is not high enough to show a significant difference from the Control. On the other hand there is a marked difference between the samples that were held for the periods of 24 and 48 hours as compared to their Controls giving Odds of 144-1 and 624-1 respectively, which are significantly high showing that there has been damage done by this particular drying process.

TABLE NO. VI.

Corn harvested in the Soft Dough Stage, artificially dried and stored in the Laboratory.

Date	Treatment F.	Hrs.	Moisture % after Treatment	Germ Sample	Germ Control	Vigor Sample	Vigor Control	Odds
Sept.2	108°F	12	42%	13	97	7.3	62.3	322-1
Sept.2	108	24	40.3%	56	98	30.0	71.0	23.9-1
Sept.2	108	24	37%	63	97	41.5	51.6	6.7-1
Aug.29	125	12	42.3%	84	98	60.0	60.0	1.29-1
Aug.29	125	24	13%	39	100	17.3	93.7	322-1
Aug.29	125	48	11.2%	15	99	6.0	94.8	9999-1
Sept.5	144	12	32%	41	99	13.3	81.9	624-1

Table No. VI shows when corn is harvested in the Soft Dough stage and dried with Artificial Heat at a temperature of 108 degrees F. for the periods of 12, 24 and 48 hours, that there is an increase in the Germination and also in the Seedling Vigor in the sample as the length of the period of exposure to that particular temperature is increased. This was evidently caused by molds as they were more abundant in the 12 hour and 24 hour than in the 48 hour period. Therefore, damage has been caused by this particular process in the 12 hour and 24 hour period when exposed to 108°F as the Odds are significantly high showing a difference from the Control. This is not apparent, however, in the 48 hour period as the Odds which are 6.7-1, which are significantly low enough that there is no difference from the Control. When the corn was exposed to 125°F for the period of 12 hours, 24 hours, and 48 hours we notice a decrease in the Germination power and Seedling Vigor in the sample as the period of time of exposure increases.

When the corn was left in the heat of 125°F for 12 hours, there was no difference in Germination Power or Seedling Vigor from that of the Control according to the Odds 1.29-1 which are not high enough to show a significant difference. In the case of the 24 hour and 48 hour periods at 125°F the Odds 322-1 and 9999-1 are high and therefore show a significant difference from the Control giving evidence of a deterioration in vitality. Although we got a Germination and Seedling Vigor result when the samples were dried at 144°F for 12 hours and stored in the Laboratory, the Odds were so high that a significant difference from the Control was the result, thus showing great damage was done from this particular process of drying.

The samples dried at 144°F for the periods of 24 hours and 48 hours did not show any germination so were evidently killed. This was also the case for the temperature of 161°F for 12, 24 and 48 hour periods.

Table No. Vll

Corn Harvested in the Hard Dough stage, artificially dried and stored in the Laboratory.

Date	Treatment Temp. F	Hrs.	Moisture % after Treatment	Germination Sample	Germination Control	Vigor Sample	Vigor Control	Odds
Sept.16	90	12	38%	99	99	93.3	93.6	1.29-1
Sept.16	90	24	36.2%	99	99	93.7	93.5	1.29-1
Sept.16	90	48	19.5%	99	99	67.9	96.1	20.3-1
Sept.14	108	12	36.3%	88	99	82.9	98.9	20.3-1
Sept.14	108	24	25.9%	37	99	44.4	92.9	61.9-1
Sept.14	108	48	14%	95	98	82.9	95.6	14.5-1

Table No. VII shows when corn is harvested in the Hard Dough stage and dried with Artificial Heat at a temperature of 90F for 12 hours, 24 hours and 48 hours and stored in the Laboratory, that it is equally as good in Germinative Power and Seedling Vigor as the Control, the Odds being 1.29-1 and 20.3-1, which are too low to show any significant difference from the Control. In the case of the samples which were dried at 125F for the periods of 12 hours, 24 hours, and 48 hours, one sample showed a difference from the Control, this being the sample dried at 125F for 24 hours, with Odds of 61.9-1 which were high. The samples dried at the same temperature but for the periods of 12 hours and 48 hours show no difference from their controls.

All samples dried at 125F, 144F and 161 failed to show any germination.

TABLE NO.VIII.

Corn harvested in the Milk Stage, artificially dried and stored in the Barn

Date	Treatment	Moisture after Treatment	Germination		Vigor		Odds
			Sample	Control	Sample	Control	
Aug.19	90F. 12 Hrs.	66%	39	98	31.3	98.4	118-1
Aug.19	90F. 24 Hrs.	54%	12	98	9.3	97.4	9999-1
Aug.19	No.Treatment	84.5%	42	99	30.9	99.1	54.9-1

Table No. VIII shows that of all the samples which were artifically dried at 90F, 108F, 125F, 144F, and 161F for 12 hours, 24 hours and 48 hours, there were only two samples, 90F at 12 hours and 24 hours that germinated. The Odds were so high that it showé that these samples were damaged by the storage in the barn, because the corn that had the same treatment and stored in the Laboratory gave good results, according to Table No.V.

TABLE NO.IX.

Corn harvested in the Soft Dough stage, artificially dried and stored in the Barn

Date	Treatment	Moisture after Treatment	Germination		Vigor		Odds
			Sample	Control	Sample	Control	
Sept.2	108F 12Hrs.	42%	26	97	21.9	98.5	1999-1
Sept.2	108F 24Hrs.	40.2%	94	97	86.7	98.1	34.5-1
Sept.2	108F 48Hrs.	37%	88	100	71.1	99.1	23.9-1
Aug.29	125F 12Hrs.	43.3%	44	99	40.9	99.7	4999-1
Aug.29	125F 24Hrs.	13%	60	99	49.8	98.0	131-1

Table No. IX shows when corn is harvested in the Soft Dough Stage and stored in the barn, that although we get a higher germination and vigor result than in Table No. VI. we have damage done to our samples shown by the Odds, which are so high that they show a significant difference from the Control. This difference indicates damage done by this particular drying and storage process. All samples dried at 125F for 48 hours and 144F, 161F for 12 hours, 24 hours and 48 hours, were totally destroyed and failed to germinate in each case as a result of this process.

TABLE NO. X.

Corn harvested in the Hard Dough stage, artificially dried and stored in the barn

Date	Treatment		Moisture after Treatment	Germination		Vigor		
				Sample	Control	Sample	Control	Odds
Sept.16	90F	12Hrs.	38%	95	98	74.1	73.6	6.7-1
Sept.16	90F	24Hrs.	36.2%	100	98	97.6	94.6	10-1
Sept.16	90F	48Hrs.	19.5%	99	99	90.7	94.5	98.3-1
Sept.14	108F	12Hrs.	36.3%	78	99	71.6	99.1	108-1
Sept.14	108F	24Hrs.	25.9%	71	99	63.4	97.7	118-1
Sept.14	108F	48Hrs.	14.0%	74	98	72.5	96.3	10-1
Sept.14	125F	12Hrs.	20%	6	99	4.1	99.0	9999-1
Sept.14	125F	48Hrs.	8%	13	99	11.2	98.2	9999-1
Sept.16	144F	12Hrs.	18%	14	97	12.1	97.7	9999-1
Sept.16	No Heat Treatment			100	99	99	99	1.66-1

Table No. X shows that corn harvested in the Hard Dough stage and stored in the barn without any artificial drying, gave better results than corn artificially dried, as it gave practically

perfect germination and vigor results with Odds 1.66-1, which are so low that it is very significant that there is no difference from the Control.

When the Temperature of 90F is used we have a decrease in vigor when exposed for 48 hours, although the germination results are perfect, the Odds are too high, thus showing damage done by that particular drying process. In the case, however, of the 12 hours and 24 hours we have no difference from the Control according to the Odds 6.7-1 and 10-1. Possibly this was due to the permeability of the seed-coat and the heat did not have time to penetrate to the inner layers of the kernel and therefore did not disturb the enzymes and cell structures.

When the temperature of 108F was used only the 48 hour period gave good results showing no difference from the Control by the Odds of 10-1. The other two periods of time, 12 hours and 24 hours, show a significant difference from the Control by the Odds of 108-1 and 118-1 respectively. This was possibly due to an evaporation of the moisture into steam within the kernel, but due to the impermeability of the seed coat in this stage of maturity, all of the steam failed to be liberated and we have an activation of the Enzymes which are later destroyed by the extreme conditions of the barn storage. In the remainder of the Table we have some samples giving a small germination and vigor result but the Odds are so very high that they show a significant difference from the Control as the result of the damage done by the drying process used in this case.

The samples dried at 125F for 24 hours and 144F, 161F for 12 hours, 24 hours and 48 hours, failed to germinate.

TABLE NO. 11.

Corn harvested in the Milk Stage, artificially dried and stored in the Greenhouse

Date	Treatment		Moisture after Treatment	Germination		Vigor		
				Sample	Control	Sample	Control	Odds
Aug.19	90F	12Hrs.	66%	78	97	62.8	95	131-1
Aug.19	90F	24Hrs.	59%	1	100	.5	95.7	9999-1
Aug.19	90F	48Hrs.	55%	18	100	15	93.3	9999-1

Table No. XI shows when corn is harvested in the Milk stage and stored in the Greenhouse that all the samples were destroyed by this process, giving a low germination and vigor result with Odds 131-1, 9999-1, and 9999-1, which are all very significantly high, thus proving them different from the Control. The remainder of the samples which were dried at 108F, 125F, 144F, and 161F at 12 hours, 24 hours, and 48 hours, gave no germination and showed no seedling vigor.

TABLE NO.XII.

Corn harvested in the Soft Dough stage, artificially dried and stored in the Greenhouse

Date	Treatment		Moisture after Treatment	Germination		Vigor		
				Sample	Control	Sample	Control	Odds
Sept.14	108F	12Hrs.	42%	39	100	8.8	91.1	172-1
Sept.14	108F	24Hrs.	40.2%	97	99	86.8	90.6	10-1
Sept.14	108F	48Hrs.	37%	32	99	21.7	86.2	624-1

Table No. XII shows when corn is harvested in the Soft Dough stage, artificially dried and stored in the Greenhouse it be-

comes very moldy, giving out of all the samples when dried at 108F, 125F, 144F and 161F for 12 hours, 24 hours and 48 hours, only one sample that was not damaged by this process, this one being 108F for 24 hours, with Odds 10-1 which are not high enough to show a significant difference from the Control.

TABLE NO.XIII.

Corn harvested in the Hard Dough stage, artificially dried and stored in the Greenhouse

Date	Treatment		Moisture after Treatment	Germination		Vigor		
				Sample	Control	Sample	Control	Odds
Sept.16	90F	12Hrs.	38%	98	97	79.6	85.5	32.2-1
Sept.16	90F	24Hrs.	36.2%	99	98	88.1	90.2	1.9-1
Sept.16	90F	48Hrs.	19.5%	100	99	84.7	85.7	8.22-1
Sept.14	108F	12Hrs.	36.3%	93	99	86.5	96.5	118-1
Sept.14	108F	24Hrs.	25.9%	76	99	74.6	97.0	1249-1
Sept.14	108F	48Hrs.	14%	72	99	65.5	97.4	999-1
Sept.14	No Treatment			96	99	83.4	97.4	10-1

Table No. XIII shows when corn is harvested in the Hard Dough stage, artificially dried, and stored in the Greenhouse, it will give equally as good results when certain temperatures are used as when stored without drying, in fact, gives better results according to this data. When the temperature 90F is used for the period of either 24 hours or 48 hours we get equally as good a germination and vigor result as the Control, thus showing no damage done by the drying and storage used in this case. With the same temperature, however, but only an exposure of 12 hours, we do not get as good results as in the former case, but rather have Odds which are so high that they show a significant difference from the Control. This is due to the molds which were quite obvious in this case. The temperature 108F is used also in this table, but the Odds are so high that they show a marked difference from the Control, indicating damage done by the storage. By the temperatures 125F, 144F, and 161F for 12 hours,24 hours and 48 hours, we do not get any germination whatsoever.

With the corn stored without any artificial heat treatment we get results equally as good as the Control.

Fig. No. 17--Good kernel (left) versus destroyed kernel (right) with the use of too high temperature.

TABLE NO.XIV.

Corn harvested in the Milk Stage, artificially dried stored in the Cellar. Only one ear of each survived, so no Odds calculated

Date	Treatment		Moisture after Treatment	Germination		Vigor		Odds
				Sample	Control	Sample	Control	
Aug.19	90F	12Hrs.	66%	100	96	90.4	94.9	0
Aug.19	90F	24Hrs.	59%	16	100	11.2	99.5	0
Aug.19	90F	48Hrs.	55%	96	100	95.6	96.1	0
Aug.19	No heat treatment			8	96	8.0	94.9	0

Table No. XIV does not show very much because only one ear of each survived the storage conditions, therefore, no Odds could be calculated and the results are not very dependable. By mere observation it appears that the corn artificially cured at 90F gave considerably better results than the corn that had no heat treatment at harvest. All samples that were stored in the Cellar showed an abundance of Mold as a result of the damp conditions and the lack of circulation when stored in an unheated Cellar. These were the only samples that survived the conditions out of thirty samples stored which had been treated 90F, 108F, 125F, 144F and 161F for the periods of 12 hours, 24 hours, and 48 hours.

TABLE NO.XV.

Corn harvested in the Soft Dough stage, artificially dried and stored in the Cellar

Date	Treatment	Moisture after Treatment	Germination		Vigor		Odds
			Sample	Control	Sample	Control	
Sept.2	108F 24Hrs.	40.2%	88	100	83.6	96.1	0

Table No. XV shows that corn that had been artificially dried at 90F, 108F, 125F, 144F and 161F at 12 hours, 24 hours, and 48 hours, there was only one ear survived the storage. This sample also shows damage by this treatment. Molds were very abundant in all samples.

TABLE NO.XVI.

Corn when harvested in the Hard Dough stage, artificially dried and stored in the Cellar.

Date	Treatment		Moisture after Treatment	Germination		Vigor		
				Sample	Control	Sample	Control	Odds
Sept.16	90F	12Hrs.	38%	92	97	87.3	96.4	17-1
Sept.16	90F	24Hrs.	36.2%	100	98	94.4	95.5	10-1
Sept.16	90F	48Hrs.	19.5%	96	98	80.2	95.5	10-1
Sept.14	108F	12Hrs.	36.3%	100	100	99.2	96.1	10-1
Sept.14	108F	24Hrs.	25.9%	24	100	16.9	96.1	999-1
Sept.14	108F	48Hrs.	14.0%	56	100	49.0	97.8	37-1

Table No.XVI shows all the samples were able to withstand the storage conditions of the Cellar except the samples that had been dried at 108F for 24 hours and 48 hours. The remainder of the samples shown in the Table show no difference in germinative power and Seedling Vigor from that of the Control as indicated by the Odds which are so low that there is no significant difference. The remainder of the samples dried at 125F, 144F and 161F for 12 hours, 24 hours and 48 hours failed to give any Germination results, when stored in the Cellar.

CATALASE ACTIVITY

Catalase is an Enzyme which is capable of splitting Hydrogen Peroxide (H_2O_2) into Oxygen (O) and Water (H_2O). It is found in practically all living matter according to Loew (20). It is found in Germinating Seeds to a great extent.

For the purpose of determining whether or not the Seeds that were harvested in an immature stage of maturity, and also those that were treated with different temperatures, differed from the seed that was mature and dried by natural air circulation, we performed a short experiment. Heinicke's water displacement method as described in Cornell Memoir No. 62 was used in the experiment. A constant water bath was used where the temperature could be kept within 1°C. Hydrogen Peroxide, and which was neutralized with Sodium Carbonate.

The seeds were ground up so they could be passed thru a 100 mesh seive. Two grams of the powdered material was placed in one side of the Y tube and 5 cc. of Hydrogen Peroxide in the other. This tube was placed in the water bath and left for 5 minutes until it came to the temperature of the bath which was at 35°C. After this period the stirring began which brought the seed powder in contact with the Hydrogen Peroxide and thus the activation began. The displacement of the water was then recorded in cubic centimeters, a count being made at the end of the period of 6 minutes.

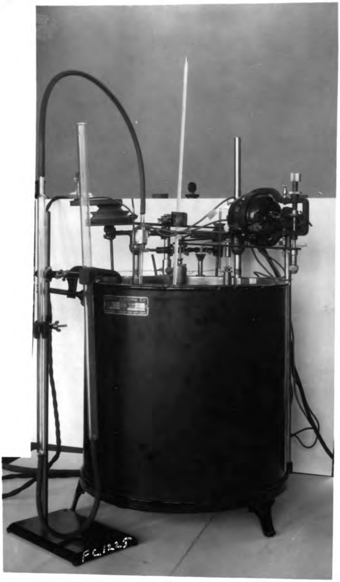

Fig. 18--Apparatus used in making Catalase Activity determinations. Notice the Heinicke water displacement apparatus on the Left.

TABLE NO.XVII.

Catalase Activity of corn samples that have been treated with Heat, compared to the Control which was dried with natural air circulation without any artificial drying.

Stage of Maturity	Treatment of Sample	Germination	Activity
Milk Stage	90°F for 24 hours	71%	10.0 cc
Milk Stage	108°F for 48 hours	0	9.2 cc
Milk Stage	125°F for 24 hours	0	8.1 cc
Milk Stage	161°F for 48 hours	0	6.0 cc
Milk Stage	No Heat Treatment	99%	9.5 cc
Hard Dough Stage	90°F for 24 hours	99%	6.0 cc
Hard Dough Stage	125°F for 24 hours	0	5.2 cc
Hard Dough Stage	144°F for 48 hours	0	5.05cc
Hard Dough Stage	161°F for 48 hours	0	5.05cc
Hard Dough Stage	No Heat Treatment	99%	4.4 cc

Catalase Activity as expressed in Table No. XVIII shows a higher activity throughout in the Immature Seed than in the more Mature Seed.

There seems to be no Correlation between the Catalase Activity and the Germination of the Seed. It is noticed that even when the Seed failed to Germinate there was still a Catalase Activity result greater than the more mature corn.

There is a decrease in Catalase Activity as the Temperature of the Heat is increased. This decrease is more rapid in the case of the Immature Seed possibly due to the thickness of the Seed-Coat, which would be thinner and more permeable than that of the Mature Seed and thus allow the heat to penetrate more readily when Drying.

As it was quite evident that the Catalase Activity was not affected to any very great extent, further research was considered unnecessary so far as this Experiment was concerned.

-CONCLUSION-

1. Immature seed corn yields higher than mature seed corn.
2. There is no correlation between the variation in the power to germinate and the resulting yield.
3. There is greater variation in the germinability of the immature seed than in the mature seed.
4. Seed in the Soft Dough stage when natural air dried gives a higher yield than either Milk stage seed or Hard Dough stage seed.
5. Milk stage seed does not withstand storage when natural air dried as well as either seed in the Soft Dough or Hard Dough stages, therefore, when planted in the field it does not give as high a germination as mature seed.
6. The earlier the stage of maturity and the higher the temperature when drying the greater the loss in germination.
7. Soft Dough stage and Milk stage seed are lowest in yielding ability dried with temperature of 112°F for 18 hours, whereas Hard Dough stage seed is not affected by an exposure to the same temperature for 24 hours.
8. Corn harvested in the immature stages of maturity and dried slowly in a moderate temperature (68°F) will retain its germinability and yield equally as well as mature corn dried in any good seed corn drying house without the use of artificial heat.
9. Corn harvested in the milk stage and dried moderately at 90°F for 12 hours and stored in the laboratory (68°F)

will give equally as good a germination percent and show strong vitality as corn harvested in the mature stage and dried by natural air drying.

10. Corn harvested in the Milk stage and dried at 90°F, 108°F, 125°F, 144°F, 161°F for the period of 12, 24 and 48 hours and stored in the greenhouse, barn or root cellar shows a decrease in viability.
11. Corn harvested in the milk stage and artificially dried at 90°F for 24 and 48 hours at 108°F, 125°F, 144°F and 161°F for 12, 24 and 48 hours and stored in the laboratory (68°F) is lowered in viability as the temperature is increased.
12. Corn harvested in the soft dough stage and artificially dried at 108°F for 24 hours and 125°F for 12 hours and stored in the laboratory showed equally as good in viability of seedling as mature corn dried by natural air drying. This holds true for corn dried at 108°F for 24 hours and stored in the greenhouse.
13. Corn harvested in the soft dough stage and artificially dried at 90°F, 108°F, 125°F, 144°F, and 161°F for 12 hours, 24 hours and 48 hours, stored in the cellar or barn will be damged and therefore not be as viable as mature seed dried by natural air drying.
14. Corn harvested in the soft dough stage and artificially dried at 108°F, for 12 and 24 hours, 125°F

for 24 hours, 48 hours and at 144 $^{\circ}$F, 161°F, for 12, 24 and 48 hours, stored in the laboratory will be damaged and, therefore, it will not give as good results as mature corn, naturally air dried.

15. Corn harvested in the soft dough and artificially dried at 108°F for 12 hours and 48 hours, 125°F, 144°F and 161°F for 12, 24 and 48 hours and stored in the greenhouse will be damaged and, therefore, lowered in viability and vitality.

16. Corn harvested in the hard dough stage and artificially dried at 90°F for 12 hours, 24 hours and 48 hours, 108°F for 12 hours and 48 hours and stored in the laboratory, dried at 90°F for 12 hours, 24 hours, or 48 hours and stored in the greenhouse, dried at 90°F for 12, 24 and 48 hours, and stored in the cellar gives equally as good results as mature corn naturally air dried, thus showing no damage done by these drying processes.

17. Corn harvested in the hard dough stage and artificially dried at 108°F for 24 hours, 125°F, 144°F and 161°F for 12, 24 and 48 hours, dried at 108°F, 125°F, 144°F and 161°F for 12, 24 and 48 hours stored in the cellar; dried at 90°F for 48 hours, 108°F for 12 and 24 hours, 125°F, 144°F and 161°F for 12, 24 and 48 hours, stored in the barn, all showed damage done by the process of drying and thus were lowered in vitality and viability.

18. All other methods of drying with the hard dough stage other than those shown above showed evidence of damage.

19. Corn harvested in the hard dough stage, artificially dried at 108°F for 24 hours, stored in the laboratory, greenhouse, barn and cellar showed evidence of damage and thus must be a critical period in the drying process.

20. Laboratory stored samples after artificial drying was used showed evidence of better results than barn, greenhouse orcellar stored samples.

21. Samples stored in the greenhouse and cellar show damage by mold more readily than samples stored in the laboratory or barn.

22. Good circulation of air is necessary in artificial drying of seed corn.

23. Catalase activity is not affected by the degrees of heat used in this experiment.

24. Catalase activity is greater in immature seeds than in mature seeds.

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