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Storage and Germination of Millet Seeds

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Introduction: The preservation of the viability of seeds is a problem to all workers engaged in crop husbandry. To a plant breeder whose work necessitates the testing of innumerable cultures, the preservation of seeds without impairing their germination capacity is of prime importance, as all the material cannot be studied at the same time and a certain period of storage is always necessary. To a farmer growing crops on a large scale, a knowledge of factors governing the viability of the seeds and the best means of preserving it is a vital necessity. The effect of certain storage treatments for preserving seeds of millets were studied at the Millet Breeding Station, Coimbatore and the present paper is a review of the results obtained.

Materials and Methods: Seeds of millets grown in the Station were used for the experiments. In the case of small quantities, the seeds were kept in wide-mouthed jars of 8 oz. capacity with tin screw tops provided with cork washers. Large quantities of grain were kept in metal bins, single and double gunnies as the case may be, as detailed under the experiments. The germination tests were conducted in zinc trays on wet blotting paper, as is usually done.

Experiment I *Viability of millet seeds under proper storage conditions:*

The object of this experiment was to find out how long millet seeds keep viable, when they are properly stored and protected from insect attack.

Well-dried seeds of millets kept in screw top bottles maintained a satisfactory germination capacity of about 70% upto three years, as indicated below:

Seeds of	Initial germination percentage	Reached 70% germination during a period of :–
1. Cholam *(Sorghum spp.)* ...	79	26 months
2. Cumbu *(Penni setum typhoides)*...	91	36 ,,
3. Ragi *(Eleusine coracana)* ...	96	32 ,,
4. Tenai *(Setaria italica)* ...	92	38 ,,
5. Samai *(Panicum miliare)* ...	92	38 ,,
6. Panivaragu *(Panicum mileaceum)*	96	38 ,,
7. Kundiraivali *(Echinochlou frumentacea)* ...	96	38 ,,
8. Varagu *(Paspalum scrobiculatum)*	88	34 ,,

(i) **Cholam:** To find out the effect of age of seed on the germination of cholam, experiments were conducted with 40 lb. of seeds in four strains Co. 4, Co. 7, Co. 8 and Co. 9 kept under proper storage conditions, i. e., in good metal bins, seed frequently dried and preserved with naphthalene balls. The seeds were tested once evey fortnight for germination, for a period of 23 months i. e., from August 1948 to June 1950.

The data are given below:

Loss in germination percentage of cholam seeds through age

	Co. 4.	Co. 7.	Co. 8.	Co. 9.
Initial germination percentage (in August, 1948)	96	93	91	92
Germination percentage in June, 1950. (after 23 months)	71	78	69	72

It will be seen that a satisfactory germination capacity about 70% is maintained in sorghum if the seed is stored under proper conditions even upto a period of two years.

(ii) **Cumbu:** To find the variations in the percentage of germination of cumbu, seeds of Co. I, obtained from the bulk crop of 1948 summer season were preserved as in the case of cholam. They were kept for germination every fortnight from the date of harvest and the percentage of viability recorded for two years. The percentage of germination in the case of Co. I was 96·5 at the start in 1948 and it maintained the same germination till June 1950. If cumbu seeds are periodically dried and preserved free from moisture and insect damage, very little of its viability is lost even after storage for two years.

Experiment II **Effect of some types of ordinary storage methods on the germination of millet seeds.*

With the object of determining the loss in germination and deterioration in storage, an experiment was started in 1948 February with seeds of cholam (Co. I) (Co. 4, Co. 5 and Co. 9) cumbu (Co. 3) ragi (Co. 1) tenai (Co. I) and minor millets (panivaragu P. V. 36) and samai (P. M. 2) Forty pounds of seeds in all the six millets were packed in (i) single gunny and (ii) double gunnies, in two sets. One set was subjected to sun drying once every month while the other set was not sun-dried. Representative samples were drawn once a month and tested for germination. Observation were also made on the insect population and bored grains in cholam and cumbu. The data are presented in Tabels I to IV.

TABLE I

Effect of different methods of storage on the germination of cholam stored in bulk

Treatments: (1) *Strains:* Co. 1, Co. 4, Co. 5 and Co. 9.
(2) Periodical drying (once a month) *Vs.* No drying.
(3) Stored in double gunnies and in single gunny bags.

Strains	Co. 1				Co. 4				Co. 5				Co. 9			
Drying or otherwise	Sun-dried.		No drying		Sun-dried		No drying		Sun-dried		No drying		Sun-dried		No drying	
Number of gunnies	Double	Single	Double	Single	Double	Single	Double	Single	Double	Single	Double	Single	Double	Single	Double	Single
Initial germination, February, 1948	90	90	90	90	97	97	97	97	93	93	93	93	96	96	96	96
After one year, February, 1949	64	66	40	33	61	61	40	37	73	75	51	58	72	63	50	44
After 1½ years, July 1949	28	21	18	8	35	24	18	15	38	31	30	24	27	20	9	4

Observations :—

(1) *Strains:* The behaviour of all the four strains is practically the same.

(2) *Periodical drying Vs. No drying:—* This factor seems to be the decisive factor in maintaining the germination of seeds. The sun-dried seeds show a definitely higher percentage of germination than seeds which are not periodically dried. At the end of one year, the sun-dried seeds showed a variation in the germination ranging from 61 to 75% while the seeds that were not dried showed a variation ranging from 33 to 58%. This shows that periodical drying of the seeds is very important, in order to keep them viable for at least one year. There is a rapid fall after one year by which time a large number of insects were noticed in both kinds of storage.

(3) *Single gunny Vs. Double gunnies storage:—* Storing in double gunnies has not shown any decided advantage over storage in single gunnies, at the end of one year. After this period, there is a rapid fall in the germination of grains in all the types of storage.

TABLE II.

Effect of different methods of storage on the germination of cumbu (Strain Co. 3)

Treatments: (1) Periodical sun-drying (once a month) Vs. No drying.
(2) Stored in double and single gunnies.

	Sun-dried		No drying	
	Double gunny	Single gunny	Double gunny	Single gunny
Initial germination percentage (in March 1948) ...	98	96	96	92
Germination percentage after one year, (March 1949)	86	86	86	83
Germination percentage after 22 22 months, (in January 1950) ...	72	68	71	50

It is seen that cumbu grains keep better in storage than cholam grains. The fall of germination from 98 to 72% in the case of sun-dried treatment after 22 months is not quite satisfactory as compared to its germination when insect population is killed by fumigation or by preserving with naphthalene balls. Under ideal conditions, cumbu maintains full germination capacity over a period of two years.

TABLE III.

Effect of different methods of storage on the germination of ragi and tenai.

Treatments: (1) Periodical sun drying (once a month) Vs. No drying.
(2) Stored in double and single gunnies.

Crop	Ragi (Co. 1)				Tenai (Co. 1)			
Drying or otherwise	Sun-dried		No drying		Sun-dried		No drying	
Number of gunnies	Dou-ble	Sin-gle	Dou-ble	Sin-gle	Dou-ble	Sin-gle	Dou-ble	Sin-gle
Initial germination percentage (in March 1948) ...	97	95	97	94	94	94	96	92
Germination % after 1 year (March 1949) ...	96	96	98	98	97	97	97	97
Germination % after 22 months (January 1950) ..	97	98	93	92	90	94	91	93

It is seen from the Table that ragi and tenai are less liable for insect attack that either cholam or cumbu. There is no difference between double and single gunny packings.

TABLE IV.

Effect of different methods of storage on the germination of panivaragu and samai.

Treatments: (1) Periodical sun drying (once a month) Vs. No drying.
(2) Stored in double and single gunnies.

Crop	Panivaragu (P. V. 36)				Samai P. M. 2			
Drying or otherwise	Sun-dried		No drying		Sun-dried		No drying	
Number of gunnies	Dou-ble	Sin-gle	Dou-ble	Sin-gle	Dou-ble	Sin-gle	Dou-ble	Sin-gle
Initial germination percentage	94	94	98	94	92	88	93	91
Germination % after one year	97	97	98	97	95	96	93	92
Germination % after 20/21 months	93	94	94	96	94	89	90	92

It is seen that like ragi and tenai, panivaragu and samai also do not require much attention as they are less liable to insect attack than either cholam or cumbu. These grains keep very well in storage.

Discussion: Provided insects and other factors are eliminated and ideal storage conditions are kept up, the seeds of all millets remain viable for a period of two years and more. From the data obtained under Experiment II, it is noticed that in the types of storage adopted, the seed deteriorated more rapidly than under Experiment I. The loss in germination at the end of the first year, was from 97% to 60% in cholam. In this type of storage treatments, it was noticed that insects were present in very large numbers, even in the bags which were periodically dried once a month. The insects were in much larger numbers in the bags that were not dried at all. So mere sun-drying and double gunnies are not sufficient to keep millet seeds viable for a satisfactorily long time. In the case of millets which are rainfed crops grown in low rainfall areas, as a consequence of periodical droughts, there is often the necessity of carrying the seed over two seasons. Experiment I has shown that millet seeds can remain viable for over two years. From Experiment II, it is seen that mere sun-drying and double gunnies are not sufficient to carry the seeds satisfactorily even for one year. If however, the insects could be prevented from attacking the grain by either fumigating the grain periodically or by preserving it with naphthalene balls or Acorus powder, satisfactory germination can be maintained for more than 2 years. Krishna Rao and Brahmiah (3) 1945—have reported that sorghum seeds at Hagari were damaged to an extent of 17·75% in the course of eight months when the grains were simply stored in a bin without any treatment while the seeds were free from insects and maintained a germination of 80% when they were treated with Acorus powder. The two factors which affect the germination of seeds are:— (1) natural deterioration due to age and (2) insect damage. If insects are controlled by fumigation or other methods, it is possible to maintain the germination of the seeds for a longer period.

Among the millets, ragi, tenai, panivaragu and samai maintained their germination at a high level over a period of nearly two years. Cholam deteriorates quickly in storage, while cumbu is a little better.

Conclusion: Well-dried and ripe seeds of millets can remain viable for a period of nearly two years provided they are kept free from insects. The common methods of storage like-sun-drying and storing in gunnies single or double keep the grains viable for less than one year. They are not sufficient to keep the seeds free from insect damage. The chief cause for the rapid deterioration of seeds in storage is insects. Fumigation and the use of naphthalene, or Acorus powder keep the seeds from insect attack and maintain good germination capacity for longer periods.

Summary: The paper reports the results of experiments done at the Millet Breeding Station, Coimbatore and elsewhere on the germination capacity of millet seeds. Ripe and well-dried seeds maintain their germination capacity for a period of over two years, provided they are protected from insect attack with the help of substances like naphthalene etc. The ordinary methods like storing the seeds in single gunny bags or double gunny bags and sun drying them once a month help to maintain the germination capacity satisfactorily for less than a year. They are unable to prevent insect damage. It is therefore necessary to have recourse to methods which control the insect damage to maintain a high percentages of germination over a period of two years of storage.

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Research Note

The occurrence of Striga on Cyanotis cucullata

Striga is a hemiparasite on flowering plants. Members of the Gramineae are usually attacked. It has been reported to be parastic on some dicotyledonous plants also.

At the Millet Breeding Station, Coimbatore, in a field of Sorghum heavily infested with Striga, *Cyanotis cucullata* was also present as a weed. Cyanotis is a common weed in Coimbatore. *Striga lutea* was found in close proximity to these weeds. To determine whether Striga was parasitic on this weed, Cyanotis plants with the neighbouring Striga plants were removed carefully along with a clod of earth; their root systems were washed and examined. Haustorial connections were observed between the parasite and Cyanotis. This species has not so far been recorded as a host for Striga.

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