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Dormancy and Germination of a few Crop Seeds

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Introduction: The importance of "good seed" is well realised in Agriculture. Good seeds are those in which every seed is capable of giving rise to a healthy plant of the kind, when placed under suitable conditions of growth. The quality of good seed is dependent upon a number of factors, such as the maturity of the seeds, purity, the methods of storage adopted, the period of storage after harvest, the age of the seed and the incidence of pests and diseases during storage. For the determination of the quality of the seed and arriving at its real value two important factors namely (i) Purity and (ii) Viability are considered. The data on germination and dormancy both published and unpublished supplied by the various Crop Specialists of the Madras Agricultural Department are summarised in this article.

1. **Paddy**: (a) *(Oryza sativa, L)*: *Dormancy*: Fifty-eight strains of paddy seeds were tested in Paddy Section for germinability commencing from one week after harvest up to several weeks after, until the seeds gave 95 to 100% germination. Short-term paddy strains showed good germination even in the first or second week from harvest, but medium and long duration paddy strains required varying "rest" periods, from three to 13 weeks. Notable exceptions to this general observation were in PTB 7, ADT 6 and ADT 7. PTB 7 is a four-months variety and it failed to give satisfactory germination till after the 9th week, while ADT 6 and ADT 7, the two long duration strains gave good germination even from 6th and 8th weeks after harvest.

(b) *Viability*: This was found to vary with different varieties. GEB 24 maintained a high viability for 13 months, after which there was a steady decline to 30%. Thereafter for another 11 months the same germinating capacity was maintained. CO 1 was good for 15 months, but dropped to 49% in 24 months. CO 2 and CO 3 showed a little more variation and after 12 months dropped to 20% in 24 months (Paddy Specialist, Station Report. 1926-27).

(c) *Storage and Germination:* Drying paddy seed material soon after threshing and then storing is very important in maintaining the viability of seeds. In non-dried lots the germination is spread out and as the seeds become older, they lose their viability very badly. Trials at Maruteru have shown that the seeds stored even in four-fold gunnies lose their viability badly during the monsoon season; but occasional dryings improved the viability in such seeds. It was also found that a high percentage of viability could be maintained by storing the seed in double gunnies, with two or three dryings in the interval.

The effect on paddy germination of napthalene used during storage to prevent insect attack, was investigated at the Agricultural Research Station, Aduthurai and the following observations have been recorded; (i) Varying quantities of naphthalene did not affect germinating capacity of the dry seeds of ADT 2, 3 and 4 for one year, after which indications of deterioration were visible, while in the case of *Jeeraga sanna bhatta* (AOB 178) a scented variety, the fall in viability was much earlier, in about six months by naphthalene treatment. (ii) Paddy varieties stored in gunny bags along with naphthalene are not affected for a period of seven months, after which the germination becomes slow. (iii) Naphthalene left with seeds soaked in water before sowing did not injure the growing embryos but if the seeds, are subjected to the influence of naphthalene vapour after germination had started, the tender radicle and plumule were injured. (iv) The combined action of naphthalene vapour and a saturated moist atmosphere seriously affect the viability of paddy seeds within a much shorter period than by humid atmosphere alone.

In the storage of paddy seed in Malabar and South-Kanara, especially with reference to strain CO 3, it is found to deteriorate during the monsoon season, when stored in gunney bags or *murra* (straw twists). Investigations with different varieties of rice have shown that there is a close correlation between such deterioration and the capacity of the grains to germinate immediately after harvest. A simple method to overcome such deterioration was evolved at the Agricultural Research Station, Pattambi. The seeds were soaked in water for about 5—10 minutes and air dried, taking care to see that they did not dry to excess. The treated and stored seeds gave 80 to 100% germination while the control gave only 12 to 30%. The treatment does not affect the yield of either the grain or straw of the resultant crop.

Paddy seed kept in cold storage at 0–4°C at Coimbatore, maintained their viability even after 15 years of storage.

2. **Millets:** (a) No work appears to have been done so far, on the dormancy of millet seeds.

(b) *Viability:* Well-dried seeds of millets kept in tin screw-top bottles have maintained about 70% germination for a period ranging from two to three years. With the preservation of large quantities of seeds for seed purposes germination tests were carried out in 4 strains of cholam (CO 4, CO 7, CO 8, CO 9) and one strain of cumbu CO 1, after storage in metal containers with frequent dryings. In cholam the initial germinations were ranging from 91 to 96% in the four strains and after 23 months of storage the germination ranged from 69 to 78%. In cumbu the germination at the start was 96·5% and this was maintained for 23 months. In Poona, Sonavne (1928) found that in cumbu germination fell from 94·5% in the first year to 61·2% in the fifth year, and in cholam the same author found the initial germination to be 89·7% and after five years to be only 79·1%.

(c) *Storage and germination:* An experiment for determining the loss in germination and deterioration in storage, was conducted in the Millets Section with *Cholam, Cumbu, Ragi, Tenai, Panivaragu* and *Samai.* Forty pounds of seeds in each were packed in (i) single gunny and (ii) double gunny and subjected to (a) sun drying once a month and (b) no sun drying under each of the two packing treatments.

(i) **Cholam:** *Periodical drying vs. no drying;* The sun-dried seeds show a definitely better germination, than seeds which are not periodically sun-dried. At the end of one year, the sun-dried seeds showed a germination ranging from 61 to 70%, as against 33 to 58% in seeds that were not dried.

Storage in single gunny vs. double gunny: Storing in double gunny did not show any decided advantage over storage in single gunny at the end of one year. After this period, there was a rapid fall in the germination of grains in all the methods of storage, due to heavy infestation by storage pests.

(ii) **Cumbu:** The grains of cumbu keep better in storage than cholam grains. There was no appreciable difference in germination between the different treatments under storage.

(iii) **Ragi, Tenai, Panivaragu and Samai:** These grains keep very well in storage and the initial germination percentages were maintained even after 22 months of storage. They do not also seem to need much attention, as they are less liable to insect attack than either cholam or cumbu. There was no difference between double and single gunny packings.

3. **Pulses:** Studies on the dormancy and viability of pulse crops have not so far been undertaken in this State. However, the little information on dormancy available from other States shows that green gram *(Phaseolus radiatus)* and black gram *(P. mungo)* gave low germination when tested immediately after harvest but improved later, with storage (Sonavne 1928). Patwardhan (1927) found that hard seeds which were more in number in the initial stages decreased with storage, thereby showing that the hard seeds both in green gram and black gram lose their hardness within a year of harvesting and storage.

Longevity: Sonavne (1928 & 1934) reports that longevity of pulse seeds range from seven to more than 12 years. The seeds gave germination over 70% even after seven years of storage, after which period there was a deterioration in germination. However, a certain proportion of the seeds continued to be alive even after 12 years, in three species (1 to 3) while the rest lost much of their viability by 10 to 12 years.

Species	Year by which 70% of germination was recorded.
1. Phaseolus radiatus	11 Years.
2. P. mungo	9 ,,
3. P. aconitifolius	11 ,,
4. Cajanus cajan	7 ,,
5. Cicer arietinum (Deshi gram)	9 ,,
6. Cicer arietinum (Kabuli gram)	7 ,,
7. Dolichos biflorus	7 ,,

4. **Groundnut:** (a) *Dormancy*: Extensive studies have been made on the dormancy of groundnut seeds (John C. M. et al 1948). The seeds of the spreading variety are dormant and need about 2 to 2½ months from harvest to give good germination. Seeds of the bunch variety have no such dormancy period.

(b) *Viability:* Groundnut kernels and pods keep their viability upto four years when stored in air-tight containers but deteriorate after 12 months when stored in ordinary gunny bags, or tins. Sonavne (1928) reports 92·6, 74.5, 60·2, 28·5 and 23·8 percentages of germinations in five successive years during storage in glass bottles, with a naphthalene ball inside.

(c) *Storage and germination:* Groundnut kernels from the summer crop (February to July), undergo deterioration in storage more rapidly than the kernels from the winter crop. (July to December). Kernels having more than 5% moisture at the time of storage deteriorate to a more marked extent than kernels having less of moisture. Kernels with a high percentage of splits and broken bits

deteriorate rapidly. Storing of groundnuts in the form of pods reduces deterioration considerably, as compared to storing them as kernels.

5. **Gingelly**: *(Sesamum orientale) (S. indicum)—Dormancy:* There is no period of dormancy for the seeds of gingelly. *Viability:* From preliminary experiments conducted in the Oil-seeds section it has been found that gingelly seeds stored in air-tight containers remained viable upto three years. In Poona (Sonavne–l. c.) the seeds kept in bottles continued to give 80·5% germination in the fifth year, while the initial germination in the first year was 85·6%.

6. **Castor**: *(Ricinus communis):* The seeds are non-dormant in castor and they keep their viability for about three years.

7. **Coconut**: *(Cocos nucifera):* No experiments appear to have been carried out on the dormancy and viability of coconut seed. The coconut seed is harvested from the parent trees when it is over 12 months old, when the husk is turning brown and drying up. The seed requires a resting period till the husk gets completely dried up.

As regards the viability of the seed it is dependent on the milk inside the seed nut. Seed nuts which do not have milk inside, very rarely germinate. Viability tests for long periods are not of practical importance in coconuts as the seed nuts will usually be planted within six months after harvest. The method of storing nuts to retain the water inside, for about six months is, therefore, important and experiments have been conducted to find out the most efficient method. Seed nuts when kept exposed in storage soon lose both the water and viability. They can however be stored for about nine months in sand without much loss in viability. Nuts harvested in march could be stored in sand for a period of even nine months, with a germination of 76%. For periods of six months and less the germination is normal, going upto 95% when the seed is preserved in sand.

8. **Cotton**: *Gossypium*, spp.: (a) *Dormancy:* Information on the dormancy of cotton seeds is not available.

Viability: Cotton seeds can remain viable even upto 19 months from the date of harvest. In cotton, the seeds required for sowing need not ordinarily be preserved for a period exceeding five months from the date of harvest, although seed stocks left over in Government Seed Farms after the season's sowings, present a serious problem. The experiments conducted by the Cotton Specialist,

Coimbatore, indicate that seeds harvested in one season, retain their viability for two successive seasons. If the germination capacity of the surplus stock at the end of the first sowing season is satisfactory, say upto 70%, periodical drying will help to maintain the seeds in a satisfactory condition for sowing in the next season. Sonavne (1928) reports only 58·6% of germination in cotton in the first year which rose to 67·3% in the second year and thereafter fell to 58·0, 55·8 and 53·3 percentage, in the third, fourth and fifth years respectively.

(c) *Storage and germination:* Experiments to ascertain the germination of cotton seeds in the lower bags when arranged in tiers indicated that the top layers recorded significantly better values in both total percentage and rate of germination. It is desirable to recommend storage of cotton seed in depots in tiers of not more than six bags.

10. **Green Manure Crops:** A few green-manure crops gave the following data in the initial germination tests and after 45 months of storage in the Botany Section, Coimbatore.

Green manure crop	Initial germination	After 45 months of storage
Sunhemp	63—77·5%	53—59%
Pillipesera	71—83%	41—47%
Daincha	82—88 5%	43·5—51·6%
Kolinji	46—52%	43—55%
Indigo	36—45%	30—42%

In Kolinji the germination increased after a few months of storage and high germinations of 71 to 82% were obtained between the 15th to 18th months of storing.

Indigo showed poor germination from the beginning. Under storage treatments of sundrying it was found that there was a decrease in germination percentage with sun-drying, while under non-sundrying the germination percentages were maintained without deterioration even after two years of storage.

11. **Fodder and Pasture Grasses:** (a) *Dormancy:* No information is available on the dormancy of grass seeds, and trials have just been initiated in the Botany section.

(b) *Viability:* The seeds of a few South Indian fodder grasses were tested for their viability (Chandrasekharan et al 1950), the seeds being stored in thick brown paper bags and tested in germination trays in the laboratory.

Only a few grasses like *Panicum antidotale* and *Enteropogon monostachyos* gave good germination, reaching 80%. The popular *Cenchrus ciliaris* and *Iseilema laxum* have only 35 to 48% germination capacity and the other grasses are even less, giving only 25% germination.

(c) *Storage and Germination:* Generally with storage, there is decrease in germination capacity every year. Many of the grasses retain their viability in the second year of storage but deterioration is evident from the third year. Except in a few, many of the grasses have lost their viability in the fourth year of storage completely. But in temperate regions pasture grass seeds retain their viability upto light or even 13 years. (Carruthers. 1911). Only in *Panicum antidotale* (Australian drought-resistant grass) the germination percentage continued to be high (65 to 87%) upto six years in storage at Coimbatore.

Discussion: It is believed that crop seeds do not germinate well when kept for more than one year after harvest. The data available on some South Indian crops presented above, show that in most cases the seeds remain viable for over two years when tested under laboratory conditions. More information remains to be gathered regarding the germination of crop seeds when stored under ryots conditions.

It is also generally believed that in humid climates, crop seeds lose their viability within a year (Robertson & Lute 1933). The viability of seeds under arid conditions have to be studied in more detail before any conclusion can be drawn. Percival (1935) recommends two years as the time within which it is advisable to sow wheat and maize seeds in temperate regions. Observations on these two crops by Sonavne (1928) in tropical conditions at Poona show that viability remained good for about five years. It is therefore, necessary to work out the viability of the crop seeds in detail for tropical conditions, to determine the time upto which they can be stored, for sowing purposes.

The percentage of germination which should be considered as good, fair and poor for each crop seed is another point which needs definition. From the data available so far the following is considered as a tentative definition of germination percentages.

Crops	Percentages of germination, on which it is considered to be		
	Good	Fair	Poor
	Above	Between	Below
Paddy	95	90—95	90
Cholam	90	80—90	80
Cumbu, Ragi, Tenai, Samai, Panivaragu, Kudiraivali	90	80—90	80
Varagu	85	70—85	70
Pulses	90	80—90	80
Groundnut	90	80—90	80
Gingelly	85	70—85	70
Cotton	80	80—80	60
Sunhemp, Pillipesara	90	80—90	80
Daincha	80	70—80	70
Kolinji	80	60—80	60
Indigo	65	55—65	85

In most of the crop seeds in the tropics, dormancy has not been studied in detail. Harrington (1916) found that dormancy exists among many species of cultivated plants. Spaeth (1934) states that "the seeds of cultivated plants have been found to be less dormant than those of the wild species from which they have been derived. Most of the causes of dormancy are hereditary; however, such characters as the impermeability of seed coat as one of the causes for dormancy, may be modified by the climate in which the seed is produced." Seeds having dormancy do not germinate before their dormancy period is over. The methods by which germination can be hastened in dormant seeds also require investigation.

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