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Effect of Storage on Germination and Viability of Soybean Seed in genotype (Glycine max (L.) Merril)

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ABSTRACT

One of the important basic needs for higher agricultural productivity is physiological quality of seed, which is characterized by viability and vigour. As soybean (Glycine max (L.) Merril) is Soybean is classified as "poor storer" as it loses viability drastically under warm and humid conditions under hot and humid storage conditions. The present research study was conducted to evaluate soybean seed material with the objectives to relate field emergence and laboratory evaluation with respect to physiological quality of soybean, with special reference to germinative evaluation criteria, to study the effect of storage on vigour and viability on soybean seeds. Seeds of soybean variety, JS-9305, JS-335, JS-9752, MAUS-158, MAUS-162, MAUS-71, MAUS-81 stored in air tight plastic containers and kept under ambient laboratory conditions. Completely randomized block design was employed with four replications.Various germinative criteria including imbibition rate, standard germination test and vigour indexes were studied. The storage of seeds resulted in deterioration of seed vigour as evident by decline in the various parameters investigated. Considering the field stand establishment (field emergence final count) as dependent parameter and various evaluation criteria as independent parameters the simple linear correlation and regression was done for individual parameters. The most rapid, easy and convenient criterion of seed vigour as reflected in terms of stand establishment (field emergence- final count) in soybean was imbibition rate after 16 hours (R2 = 0.445). The other significant evaluation criteria for the prediction of seed vigour in soybean were laboratory germination (particularly final count) and vigour indexes.
Keywords : Soybean, Glycine max, Seed germination, Storage condition

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INTRODUCTION

Soybean is finding its place in policy agenda of industrial, medicinal and food sector of India due to wide spectrum of its chemical composition. The dry seed of soybean is rich source of phosphorous, potassium, sulphur, iron, vit. A, D, E, K and unsaturated fatty acid with the anti-cholesterol principle. While its sprout contains appreciable amount of vitamin C which is generally obtained from fresh fruits and vegetables.

Soybean oil is low in saturated fat and high in monounsaturated and polyunsaturated fat. It is widely used as 'vegetable oil". Soybean oil also contains the essential fatty acids linoleic and linolenic, required for human health Soybean oil rich in omega-3 fatty acids, is believed to reduce the risk for heart diseases and may prevent osteoporosis. It also contains phytosterols which could lower LDL cholesterol. Soybean oil does not contain cholesterol (Kakde and Chavan. 2012). Developing seeds attain maximum viability and vigour at physiological maturity (defined as the stage when seeds reach maximum dry weight during development) and with age, the viability and vigour decline, thereafter (Harrington, 1972).

Soybean (Glycine max (L.) Merrill) is one of the world's leading sources of vegetable oil and plant protein. As the world demand for vegetable oil and protein meal continues to increase, soybean production has spread rapidly from the temperate zone into the hot and humid tropics. It is an important food crop and possesses 40-42% protein and 20-22% oil in its seeds making it highly suitable for human food, animal feed and infant food product. It is also rich in vitamins, phosphorous and iron.

Soybean is being cultivated in the Himalayan region from time immemorial but the lower yield potential of the traditional cultivars has restricted its large-scale adoption. Among other constraints which hinder

soybean production are the deterioration of seed quality under ambient storage conditions and several biotic and abiotic factors. Soybean is classified as "poor storerSoybean is classified as "poor storer" as it loses viability drastically under warm and humid conditions under hot and humid storage conditions, oilseeds frequently become invaded by storage fungi (Nandi et al., 1982). Deterioration of seed during storage is manifested as a reduction in percent germination while those seeds that germinate produce weak seedlings which ultimately affect the growth and yield of crop plant (Tekrony et al., 1993). The physiological quality of seed related to its vigour and viability, is affected mainly by its moisture content and the exposure of seed lot to fluctuating temperature and RH conditions.

Quality parameters of seed such as oil content, fatty acid composition and protein content are significantly influenced by storage conditions and lime (Ghasemnezhad and Honermeier, 2007). Peroxidation of unsaturated fatty acids is considered to be one of the main reasons for poor storability of soybean seeds, which also results in the production of high level of volatile aldehydes during the course of aging (Dadlani, 1999). During storage, seed absorb or lose moisture until the vapour pressure of seed moisture and atmospheric moisture reach in equilibrium. The seed moisture attained under these conditions is referred to as equilibrium moisture content.

Soybean is an orthodox seed and has short storage life. In orthodox seeds (i.e. seeds which tolerate dehydration), accelerated aging can be artificially induced at high temperature and high relative humidity (RH) (Priestley. 1986). Seed aging had significant effects on electrical conductivity and seed germination traits (Mohammadi et al., 2011). The rate at which seed aging take place depend on ability of seeds to resist degradation changes, specific to each plant species (Tubic et al., 2010).

MATERIALS AND METHODS

The seeds of soybean genotype are produced from Soybean Research Station V.N.M.K.V, Parbhani. The experiment was conducted at laboratory. Department of Agricultural botany. VNMKV, Parbhani.

The seed of each entry were stored Oct 2016 onward in air tight plastic container kept in the laboratory under ambient condition. The sample were be drawn for various observation at one month interval till the seed germination declines considerably below Indian minimum seed certification standard.

1. Determination Seed moisture (%)

Four grams of seed sample per replicate of each entry were weighed on electronic balance and dried in an oven at 1300 C for 2 hours. (ISTA, 1985). Average value was presented. Seed moisture was calculated as per formula given below.

$$\text{Seed moisture (\%)} = \frac{\text{actual Sample sample} - \text{Oven Dry weight}}{\text{Actual sample weight}} \times 100$$

Assessment of seed viability

The tetrazolium test was performed according to the procedure devised by International Seed Testing Association (1999). One hundred seeds from each seed lot of soybean or niger were used for this test in five replications of 20 seeds each. The seeds were soaked in distilled water for 24 h before staining to allow complete hydration of all the tissues. The seeds were then bisected longitudinally to expose the embryo and stained with 1% solution (w/v) of triphenyl tetrazolium chloride (TTC) made by dissolving the 2,3,5 TTC in double distilled water. The seeds were then placed in 1% TTC solution in petridishes on double sheets of Watman No.1 filter paper moistened with distilled water, which were then covered with aluminum foil and incubated at 30 ± 1°C temperature in dark for 36 h.

The tissues of the living cells of the seed took up the stain in different patterns during this period. After staining, the solution was drained off and seeds were rinsed with tap water. Viability of each seed was interpreted according to the topographical staining pattern of the embryo and the intensity of the colouration with the help of magnifying glass and the pattern of each individual seed was recorded under three staining categories, completely colored embryos (viable), partially coloured (potentially viable) and completely colorless embryos (not viable).

Statistical analysis

The data were analyzed as per completely randomized design (Gomez and Gomez, 1983). Simple correlation and regression analyses between field emergence (final count) and other individual evaluation criteria were also carried out.

RESULTS AND DISCUSSION

The results for the moisture content of soybean showed that soybean seeds lost their moisture after four month of storing period. The moisture contents for the seeds from dec-2016 to Mar-2017 were significantly different from that of seeds of 2017. (Table.1 and fig No. 1)

The germination studies of the seeds of different storage periods for the soybean showed that no seed started germinating after 24,36,48.72,and 7 day. After 7th day, showed 85% germination .
The seed viability studies were performed using tetrazolium (TZ) test. Upon staining with TZ, only 95% seeds from Dec-2016 harvest showed completely couloured embryos, while 10% seeds showed partially coloured enbroys. The soybean seeds, higher the number of partially colored seeds was found. (Table 2 and fig 2).
Changes occurring in seed during storage are valuable study tools to study seed quality and seed longevity. The seeds containing high oil percentage show considerable changes in the chemical composition under specific environmental and aging conditions. The soybean are the one important oilseeds of Madhya Pradesh (India) and hence the studies on the seed germination under different storage conditions is a prerequisite to identify the best storage conditions for the seeds to minimize the deterioration rates. The results clearly indicated that the soybean seeds lost moisture at a higher rate, and this may be the prime reason why the older seeds of soybean failed to germinate. The results were supported by the electrolyte leakage and tetrazolium viability tests. Earlier, Gladys et al. (2012) have shown that the soybean varieties can maintain high viability for up to 12 months under all tested storage conditions,and untreated seeds' viability declined drastically after one year.
In another study by Tubic et al. (2010), a comparison of storage conditions on seed viability of soybean and sunflower seeds showed that soybean seeds are more sensitive to damage and reduced germination during storage. Further, the authors discussed that in addition to the cultivar, storage conditions, and duration were significant factors affecting the germination rates of soybean.

Table.1 Moisture percentage of stored seeds of soybean genotype.

Treatment	Dates of Sampling			
	Dec -2	Jan-1	Feb-1	Mar-1
MAUS158	8.70	8.28	7.32	7.22
MAUS162	8.40	8.27	7.25	7.17
MAUS71	8.55	8.30	7.47	7.23
MAUS81	8.60	8.38	7.54	7.24
JS335	9.80	8.46	8.70	7.85
JS9305	10.58	10.38	9.55	8.00
JS9752	8.32	8.28	7.25	6.34
Mean	8.99	8.63	7.87	7.29
S.Em.±	0.29	0.18	0.22	0.30
C.D at 5 %	0.87	0.55	0.67	0.89
C.V %	6.53	4.33	5.77	8.31

Table.2 Viability soybean genotype of seeds stored for different periods under ambient conditions.

Treatment	Dates of Sampling			
	Dec -2	Jan-1	Feb-1	Mar-1
MAUS158	88.75	84.75	81.75	79.75
MAUS162	87.75	83.75	80.75	78.75
MAUS71	89.50	85.50	82.50	80.50
MAUS81	91.25	87.25	84.25	82.25
JS335	92.75	88.75	85.75	83.75
JS9305	93.25	89.25	86.25	84.25
JS9752	84.50	80.50	77.50	75.50
Mean	89.68	85.68	82.68	80.68
S.Em.±	1.19	1.19	1.19	1.19
C.D at 5 %	3.53	3.53	3.53	3.53
C.V %	2.66	2.78	2.88	2.96

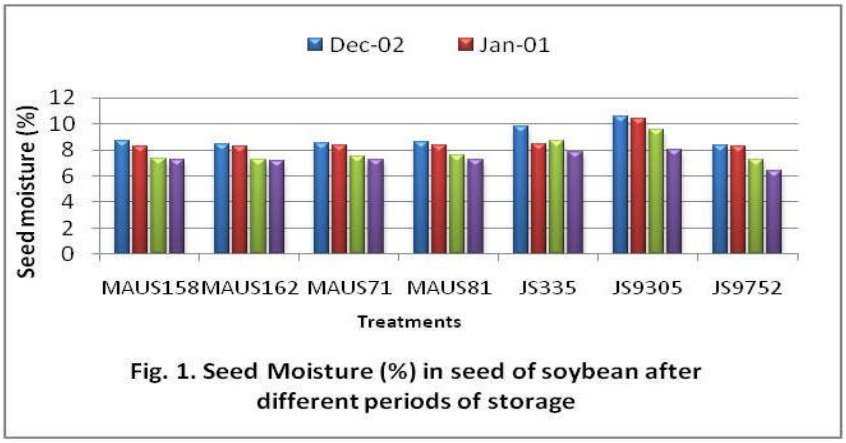

Fig. 1. Seed Moisture (%) in seed of soybean after different periods of storage

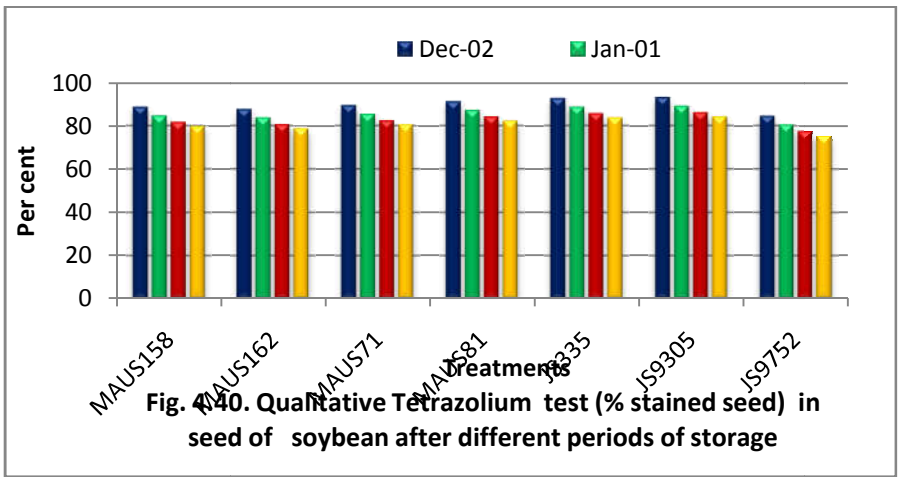

Fig. 140. Qualitative Tetrazolium test (% stained seed) in seed of soybean after different periods of storage

It has been established fact now that the longevity of the seeds under storage conditions exert significant influence on germination of the seeds (Nkang and Umoh, 1997). The degree as well as speed of decline in seed vigor depend strongly upon plant species, storage conditions as well as quality of the initial seeds (Tubic et al., 2005). One more reason why soybean seeds showed decreased seed quality may be the fact that the radicle of the soybean embryonic axis is susceptible to deterioration because of its proximity to the funicular end. Because of this, the seed is directly in contact with both water and oxygen, which enter through the hilum causing lipid peroxidation compromising the seed vigor and quality.

The present study concludes that the seeds of soybean cannot be stored for more month loss of seed germination capabilities.

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