A Study on Suitability of Tetrazolium Test in Determining Seed Viability, Germination and Seedling Vigour of Cashew (*Anacardium occidentale* L.)

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ABSTRACT

Results of a comparative test on germination and viability of ten cashew seed samples of 300 seeds each, stored under five different storage conditions namely gunny bag, poly sac bag, sealed polythene bag kept under room temperature, sealed polythene (300 gauge) bag under 4^{0}C and air tight metallic bin storages were analyzed after different storage periods to reveal the optimal storage, against viability loss and to study the possibility of introducing a quick laboratory seed testing method with 2,3,5-triphenyltetrazolium chloride, over the conventional germination test. The seeds stored under 4^{0}C in sealed polythene bags and air tight metallic bins, showed significantly higher seed vigour and germination ability compared to other treatments. Furthermore, a relationship between the temperature inside the propagator and the germination percentage could also be observed, showing higher germination ability with the increased temperature. Higher correlation coefficients resulted between seed viability and field germination suggested that 2, 3, 5-triphenyltetrazolium chloride can be used in 1% solution with a staining period of 10 hours at 32^{0}C in dark, to predict field germination ability of cashew seeds with 80.31% reliability. However, it is necessary to identify a better method of interpretation of staining pattern of the tetrazolium test in order to predict the seedling vigour of cashew.

KEYWORDS: 2, 3, 5-triphenyltetrazolium chloride, Cashew, Germination, Storage, Viability, Vigour

INTRODUCTION

Cashew has been identified as a low input plantation crop. Despite the minimum care given, it yields well (4-5kg/tree/year) and is capable of producing a much greater yield (an average of 8-10kg/tree/ year) under intensive cultivation. The total extent of 32873ha of cashew in Sri Lanka produces 6197mt of nuts with an average annual kernel production of 1200mt (Jayasekera and Kodikara, 2003). Amongst horticultural crops, it gives higher return for a given investment which is an easily marketable commodity with a growing export demand.

Cashew planting will counterbalance deforestation and desertification (Rudiger, 1996). It gives protection against coastal dunes, helps soil binding and protection, prevents soil erosion and brings nutrients to the surface.

Cashew can be propagated by either sexual or asexual methods. Being cross-pollinated, cashew depends on vegetative propagation methods to conserve desirable characters of mother plant in future generations. Jayasekere (2003) revealed that continuous propagation by seeds could have a "dilution effect" on the genotype of cashew. However, in the study of Lenka *et al.* (1999) to assess genetic divergence in cashew, found that the same cultivar with specific traits could also be used in a hybridization programme for exploiting hybrid vigour. Unknowing to those arguments of the scientists, seed propagation of cashew, is the most common method, which is still in practice commercially, in spite of the availability of various standardized vegetative propagation methods (Mandal, 1997). But it is obvious to use only sound seeds from selected high yielding strands or clonal seed gardens to assure its quality (Wait and Jamieson, 1985). Vigorous seeds are used to produce good quality seedlings and root stock.
In cashew micro propagation, the tissue sources are mainly taken either from seeds or seedlings (Rudiger, 1996).

However, it is recognized that the most important component in propagation of a crop is the genetic potential of a seed. Apart from that, the maturity at harvesting, the method of storage and duration of storage would affect in the loss of germination percentage of a seed lot. Seed deterioration is an inexorable process which usually commences at the time seeds attain their physiological maturity and proceeds throughout the storing period. The final consequence of the deterioration is the failure of seeds to produce normal seedlings (Anon, 1983).

Since cashew has high oil content in seeds, it deteriorates rapidly due to lipid oxidation process as in other oil seed crops. The rate of deterioration can be identified by time taken to reduce seed viability, germination percentage, seedling vigour and increased electrical conductivity of seeds.

One of the major responsibilities of cashew development agencies is to increase the availability of quality planting materials through the provision of adequate knowledge to the farmers.

Seeds of a particular seed lot should be tested for seed quality before obtaining seeds for propagation. Germination percentage is a good parameter of seed quality. One disadvantage of conventional germination test is that it requires a minimum period of two weeks to get the results. Tetrazolium test, which uses 2,3,5-triphenyltetrazolium chloride (TZ), remains as one of the seed industries most rapid and useful method, to assess seed quality. In addition, the test is simple to conduct and does not require more time and elaborate laboratory facilities. Therefore, this experiment was carried out to study the possibilities of using tetrazolium test for the determination of seed viability and to identify a better seed storage method for cashew.

MATERIALS AND METHODS

This experiment was conducted in the Faculty of Agriculture and Plantation Management, Wayamba

University of Sri Lanka, Makandura from May 2004 to May 2005. The study composed with two trials of each having five months, and was assumed that the second trial was an absolute repetition of the first trial.

Each trial consisted of four steps such as pretest, testing seed viability by tetrazolium test, testing actual germination percentage and testing seedling vigour.

According to the design of the experiment, 1500 cashew seeds were required to carry out a trial, and it was 300 seeds per month. Seeds were obtained from the seed garden of Sri Lanka Cashew Corporation (SLCC). Initially seeds were sun dried for 2-3 days to reduce the moisture content to 16% to 17% after harvesting. It was again exposed to direct sun for another 3 to 4 hours before the experiment. Well developed, medium size nuts with good shape and appearance were randomly selected from the seed lot and stored under five different conditions namely poly sac storage at room temperature (T1), sealed polythene bag at 4^0C (T2), air tight metallic bin (T3), gunny bag storage at room temperature (T4) and sealed polythene bag at room temperature (T5).

1. Pretest

Before starting the experiment, a pretest was done using 30 seeds to test seed viability and another 30 seeds to test the germination percentage.

After that, on the fifth day of each month, 60 seeds were drawn from each storage separately and were divided into two samples of 30 seeds each. One sample was used to test the seed viability and the other was sown in a propagator to test the germination.

2. Seed Viability by Tetrazolium Test

The five seed samples of 30 seeds were soaked separately in clean water for 24 hours, using five labeled plastic bowls. After 24 hours, seeds were taken out from water and the pericarp was removed using a special cashew knife. The pericarp was removed without separating two cotyledons and the kernels were put into clean water to facilitate removal of testa. This was carried out without damaging embryo or cotyledons. 1% tetrazolium solution was prepared by dissolving 10g of 2,3,5-triphenyltetrazolium chloride in 1 liter of distilled water in a clean glass beaker. The test was conducted having 3 replicates per treatment. Empty jam bottles (15 nos.) were used for 5 treatments and 65ml of 1% TZ solution was poured into each bottle to submerge all the kernels in the solution.

The bottles were labeled and incubated in dark for 10 hours for optimum staining under 35^0C. The seed staining pattern was observed carefully and was sketched after taking out kernels into a petri dish kept over a white paper, in four hour intervals. According to the staining pattern, seeds were grouped into viable and nonviable seeds.

Principle

2,3,5-triphenyltetrazolium chloride is a water soluble, diffusible and colourless compound. It is reduced by respiratory enzymes (dehydrogenases) to triphenylformazon, which is non-diffusible red colour compound. Thus, if respiratory activity is present, which is presumed to be a sign of metabolism, the seeds will turn red and are considered "viable".

Seed viability was determined according to the criteria for evaluating the staining pattern of legume seeds (Grabe, 1970), which was tested to evaluate viability of cashew seeds (Ratnayake, 2002).

Viable Seeds:

Viable seeds are the seeds which have one of the following staining patterns.

1. Seed completely stained.
2. Stained seeds with minor unstained area on cotyledon.
3. Stained seeds with minor unstained area on upper portion of radicle.
4. Stained seeds with radicle tip unstained and minor unstained spots on cotyledon.

Non-viable Seeds:

Non-viable seeds are the seeds which have one of the following staining patterns.

5. More than extreme tip of radicle unstained.
6. At the point of attachment of cotyledon and radicle-hypocotyl axis unstained.
7. Near point of attachment of cotyledon and radicle-hypocotyl axis unstained.
8. Unstained area around radicle-hypocotyl axis.
9. Unstained area on radicle-hypocotyl axis and at the point of attachment of cotyledons to axis.
10. More than half of cotyledon tissues unstained.
11. Radicle-hypocotyle axis unstained.
12. Stained with pale, off colour, grey or glassy red.
13. Seeds completely unstained.

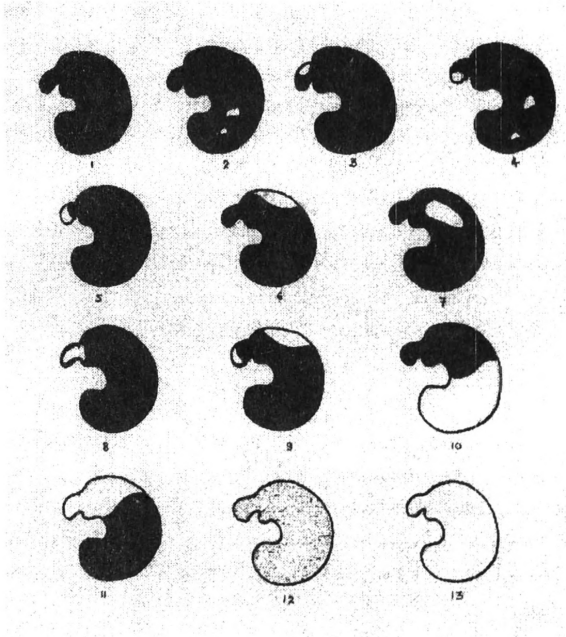

Figure 1. Determination of viable and nonviable seeds.
[Note: Black areas indicate stained, living tissues. White areas represent unstained and dead tissues].

3. Seed Germination

The other set of the seeds (30 seeds), drawn from each sample was used to test the germination percentage of cashew. The five seed samples of 30 seeds were soaked separately in 2g/l Captan (Captan W.P. 50%, Cu fungicide) solution using five labeled plastic bowls. The seeds were allowed to soak for 36 hours before sowing in a nursery.

The treated seeds were sown in beds of 90cm wide, 150cm long and 15cm hight, filled with pure sand to improve drainage. The seeds were placed vertically, to stalk end upwards at 6cm depth in sand, with a spacing of 7.5cm x 12.5cm. The bed was covered completely with 300 gauge transparent polythene at a 60cm height, to make it as a sealed propagator.

During the first week of transplanting, watering was done twice a day and followed by once or twice a day to maintain high relative humidity (RH) of over 85% inside the propagator. A "wet and dry bulb thermometer" and a "maximum and minimum thermometer" were hanged inside the propagator for daily recording of RH and temperature. Number of germinated seeds was recorded in each treatment, and it was observed up to 20 days from the date of sowing.

All the seeds, which were released out from the pericarp having unfolded cotyledons with plumule, were taken into account. The experiment was laid out in a Completely Randomized Design with 3 replicates. Data were analyzed using statistical analysis system (SAS, 1991), by CATMOD and PROBIT procedures.

4. Seedling Vigour

Germinated seedlings of four leaf stage were transplanted into black polythene (300 gauge) pots of 25cm x 15cm filled with a mixture of sand, compost and top soil in equal portions.

Seedlings were transplanted carefully without damaging to the roots. Rock Phosphate was applied (5g per pot) at the time of transplanting.
Drainage holes (10nos.) were prepared at the bottom and sides of each polythene pot, to facilitate drainage.

The seedlings were maintained under indirect sun for 2 weeks after transplanting and were transferred to a net house (74% light). All the management practices were carried out according to Wickramasinghe (2003) and following parameters were recorded for the first 3 months.

1. Seedling height (cm) from the base of the cotyledons to the apical bud.
2. Number of leaves.
3. Leaf area (cm^2) using leaf area meter (Model AM 100-256002).

The seedling height and the number of leaves were recorded weekly and the leaf area was recorded in monthly intervals up to 3 months. Data were analyzed using analysis of variance and Duncan's New Multiple Range Test to estimate the seedling vigour according the treatment.

RESULTS AND DISCUSSION

1. Pretest

Table 1.Germination and viability at the pretest

	Viability %	Germination %
Trial 1	100	90
Trial 2	100	95

Pretest results showed that the highest percentage of viability and germination (Table 1) were recorded at the time of storage. Results were more or less similar to the viability and germination percentages obtained during the initial months of storage (Table 2). It implied that, there is no significant effect of storage method on viability and germination of cashew seeds during first 2 months of storage.

2. Seed Viability by Tetrazolium test

It is obvious that the viability of any seed sample reduces with the time under any of the environmental conditions. The most important fact is that the seeds have to be protected from deterioration until they use for seed purpose. The highest viability retained among the similar samples drawn from each storage method, could be regarded as the best storage condition for cashew. A gradual reduction of seed viability was observed along with the storage period under all the tested storage conditions. There was a significant difference in seed viability after one month of storage when the seeds were stored in air tight metallic bin (T3) and in sealed polythene bags under 4^0C (T2), compared to other storage conditions (Table 2). A less than 40% viability loss was recorded in the trial 1 after five months of storage in T2 and T3, and it was significantly lower than that of other samples drawn from sealed polythene bag kept under room temperature (T5), poly sac storage under room temperature (T1) and gunny bag storage (T4).

Even though some differences observed in the results of trial 2 during the early months of storage, they followed the same pattern at the later part of the experiment. So, the conclusions could not be affected, since both studies revealed that T2 and T3 have the ability to maintain higher seed viability for a longer period of time. According to Mandal (1997), high moisture contents accelerate the seed deterioration process. Controlled absorption of atmospheric moisture and air circulation which helps in minimizing respiration in both T2 and T3 could be the main reason for minimum seed deterioration. As stated by Mandal (1997), seeds stored in gunny bags can lose viability completely at the end of 11 months. If the gunny bags placed on the floor, can uptake more moisture and might loose their viability within a shorter period.

3. Seed Germination

In cashew, seed germination takes place at any time between 7 days to 28 days from sowing but vigorous seedlings can be obtained among the first 50% of the germinated seeds (Wickramasinghe, 2003). The highest germination percentage was observed in the seeds stored in air tight metallic bin (T3) and sealed polythene bag at 4^0C (T2) in the trial 1, following similar results of the viability test. Though the results showed some ambiguity in the initial months of storage in the trial 2, it gave the similar results after 5 months of storage loosing less than 40% germination in T3 and T2.

Table 2. Impact of storage method and storage period on viability and germination of cashew seeds

	Viability %					Germination %				
Trial 1	1MAS	2MAS	3MAS	4MAS	5MAS	1MAS	2MAS	3MAS	4MAS	5MAS
T1	90.4^{b}	83.3^{a}	79.1^{b}	66.6^{b}	51.8^{b}	90.0^{b}	-	66.6^{b}	56.6^{b}	50.0^{b}
T2	100^{a}	90.9^{a}	88.0^{a}	80.0^{a}	62.9^{a}	90.0^{b}	-	76.6^{a}	66.6^{b}	60.0^{a}
T3	96.6^{a}	91.3^{a}	87.5^{a}	80.0^{a}	66.6^{a}	93.3^{a}	-	73.3^{a}	76.6^{a}	63.3^{a}
T4	87.5^{b}	66.6^{b}	61.5^{c}	51.8^{c}	40.7^{c}	83.3^{b}	-	56.6^{b}	63.3^{b}	33.3^{c}
T5	88.0^{b}	84.0^{a}	66.6^{c}	66.6^{b}	44.4^{c}	86.6^{b}	-	50.0^{b}	60.0^{b}	53.3^{b}
Trial 2										
T1	78.0^{b}	71.5^{b}	65.0^{b}	52.6^{b}	45.5^{b}	83.3^{c}	66.6^{b}	83.3^{b}	55.5^{b}	50.0^{b}
T2	97.5^{a}	96.3^{a}	84.5^{a}	67.7^{a}	56.2^{a}	72.2^{c}	100^{a}	66.6^{b}	72.2^{a}	66.6^{a}
T3	100^{a}	98.7^{a}	81.3^{a}	66.2^{a}	54.2^{a}	94.4^{a}	100^{a}	77.7^{a}	66.6^{a}	66.6^{a}
T4	84.3^{b}	75.0^{b}	52.0^{c}	43.7^{c}	39.2^{c}	100^{a}	50.0^{c}	44.4^{c}	38.8^{c}	33.3^{c}
T5	87.5^{b}	78.2^{b}	67.7^{b}	56.2^{b}	48.6^{b}	88.8^{b}	66.6^{b}	44.4^{b}	38.8^{c}	38.8^{c}

[Note: In a column, means of the given trial followed by common letters are not significantly different by DNMRT ($p < 0.05$) (T1=poly sac storage under room temperature, T2= sealed polythene bag under 4^{0}C, T3=air tight metallic in storage, T4= gunny bag storage at room temperature, T5= sealed polythene bag at room temperature, MAS= Month (s) After Storage)]

One can argue that germination of seeds stored under refrigerated condition (T2) could be affected by subjecting continuous cooling and rewarming cycles due to interrupted electricity supply. However, in a study conducted for cereals, legumes and vegetable seeds (Specht *et al.*, 1997 - 1998) which had been subjected to 200 freezing and rewarming cycles showed an insignificant difference in germination ability of less than 5% for all the species. The germination could be affected if the duration exceeds more than 24 hours.

Seed treatment is usually not required for cashew as there is no dormancy problem (Wickramasinghe, 2003). But pre soaking for 36 hours in water promotes germination (Ratnayake and Jayasekera, 2001). It may be due to water imbibition and increase of the permeability of pericarp. There is evidence that microwaving of a seed will improve its ability to germinate which may be due to the increased permeability of pericarp. However, in the present study, a 24 hour soaking was carried out to enhance the germination.

4. Seedling Vigour

A decreasing trend of all seedling vigour measures was noticed according to the storage period due to increase of seed deterioration. The significant difference observed in plant height according to the storage method at the initial period was further increased at the latter part (4 and 5 months after storage) of the study (Table 3).

However, there was no significant difference in leaf area and leaf number of different seed storage methods during the early months of storage. Effectiveness of the storage condition was significantly shown in the means at five months of storage. Even in the individual samples the difference was significant in each treatment at the end of three months. In both trials, the mean height, mean leaf area, and mean leaf number were significantly higher in the seeds stored in the metallic bin storage (T3) and in sealed polythene bag, under 4^{0}C (T2).

The lowest values of the three seedling vigour parameters were observed in the seeds stored in gunny bag under room temperature (T4), which is considered as the conventional storage method of cashew, for seed purpose.

Seeds stored in sealed polythene bags under room temperature (T5) and in poly sac storage under room temperature (T1), showed better results than the gunny bag storage (T4), but were significantly lower compared to (T2) and (T3). There were some ambiguous results with higher seedling height and leaf number in the seeds stored inside the gunny bag which was considerably deviated from the observations of tetrazolium and germination tests. This may be due to some exceptional characters of the seeds. Ambiguous evidence of relationships of seed characters and growth parameters did indicate clonal differences and nut-set in the different sides of the canopy (Masawe *et al.*, 1996). The seedlings were not allowed to face water stress during the first three months. The field studies confirmed that the available water is a limiting factor for cashew growth, despite of low soil fertility (Rudiger, 1996).

No other fertilizer was added to the pots in addition to 5g of Rock Phosphate which was mixed at the time of transplanting. The mortality rate was high in the newly transplanted seedlings. The success rate of transplanting bare rooted seedlings varies with the age (Rudiger, 1996). In the work of Jayasinghe and Jayasekera (2002), revealed that transplanting 12-15 day old seedlings is best for cashew. But in this experiment, four leaf stages was regarded as the relevant time for transplanting, irrespective to the seedling age spent inside the propagator. Apart from water and fertilizer, salinity and pH also could have some effects on the seedling growth. Whatever the method used to store the seeds, the seedlings could be affected by the above factors when growing in the field. In the findings of Valia and Patil (1997), all the physiological processes and growth components showed negative impact with the salinity level in the soil.

Table 3. Effect of storage method and period on seedling vigour of cashew

	Mean height (cm)					Mean leaf area (cm^2)					Mean leaf number				
	1MAS	2MAS	3MAS	4MAS	5MAS	1MAS	2MAS	3MAS	4MAS	5MAS	1MAS	2MAS	3MAS	4MAS	5MAS
Trial 1															
T1	12.6^{b}	-	11.8^{cd}	13.1^{ab}	17.3^{a}	170.0^{a}	-	141.6^{a}	114.1^{a}	058.2^{b}	5.0^{a}	-	4.4^{a}	5.5^{a}	5.0^{b}
T2	21.7^{a}	-	16.4^{a}	14.8^{a}	17.2^{a}	234.4^{a}	-	192.5^{a}	132.9^{a}	118.5^{a}	6.1^{a}	-	5.5^{a}	7.5^{a}	7.1^{ab}
T3	18.9^{a}	-	14.4^{ab}	13.1^{ab}	19.8^{a}	205.0^{a}	-	193.0^{a}	169.4^{a}	132.6^{a}	5.3^{a}	-	6.6^{a}	7.4^{a}	6.8^{ab}
T4	15.0^{b}	-	13.5^{bc}	10.7^{c}	19.2^{a}	181.5^{a}	-	157.6^{a}	114.9^{a}	98.2^{ab}	6.9^{a}	-	6.3^{a}	5.3^{a}	8.8^{a}
T5	19.9^{a}	-	10.6^{d}	12.2^{bc}	13.2^{b}	194.1^{a}	-	120.9^{a}	107.2^{a}	061.5^{b}	6.5^{a}	-	4.8^{a}	5.4^{a}	4.6^{b}
Trial 2															
T1	20.2^{cd}	21.7^{a}	17.6^{bc}	14.1^{b}	12.8^{bc}	130.6^{ab}	175.1^{a}	117.4^{a}	159.1^{a}	91.9^{ab}	5.3^{a}	5.7^{a}	6.1^{a}	5.6^{a}	2.0^{ab}
T2	18.3^{d}	22.0^{a}	17.2^{bc}	15.1^{b}	14.2^{b}	118.4^{b}	209.2^{a}	129.1^{a}	126.8^{a}	136.0^{a}	5.1^{a}	6.0^{a}	6.2^{a}	5.9^{a}	5.1^{ab}
T3	24.8^{a}	23.1^{a}	20.6^{a}	19.7^{a}	16.2^{a}	201.8^{a}	143.3^{a}	151.8^{a}	155.5^{a}	156.7^{a}	5.4^{a}	5.5^{a}	5.5^{a}	6.8^{a}	6.1^{a}
T4	21.9^{bc}	19.8^{a}	18.9^{ab}	14.4^{b}	09.3^{d}	145.4^{ab}	102.5^{a}	109.3^{a}	080.5^{a}	055.5^{b}	5.3^{a}	5.5^{a}	5.7^{a}	5.1^{a}	1.3^{b}
T5	23.6^{ab}	22.9^{a}	15.8^{c}	14.2^{b}	11.3^{c}	168.1^{ab}	117.9^{a}	114.0^{a}	102.9^{a}	91.6^{ab}	5.9^{a}	6.0^{a}	5.3^{a}	5.9^{a}	5.2^{ab}

[Note: In a column, means of a given trial followed by common letter(s) are not significantly different by DMRT 5 %(T1= poly sac storage under room temperature, T2= sealed polythene bag under 4^{0}C, T3=air tight metallic bin storage, T4= gunny bag storage at room temperature, T5= sealed polythene bag at room temperature, MAS= Month (s) After Storage].

5. Effect of Temperature on Seed Viability and Germination

The highest value in each seed sample tested was observed in the viability test except in the sample of 5 months after the storage in the second trial. Figure 2. and Figure 3. showed some relationships of germination with the temperature and temperature fluctuations. The gap between the viability and germination in a given seed sample showed a considerable decline under higher maximum and minimum temperatures and when the minimum temperature was closer to the maximum temperature. This higher temperature fluctuation could be a reason to destroy all the seeds in the propagator by a pathogen attack. Development of high heat inside the propagator could be able to control the incidence of pathogens.

Apart from temperature and humidity, germination depends on the status of the seeds. Highest percentage germination occurs around 35^{0}C (Wickramasinghe, 2003). Germination rate can also be affected by the variety used (Ratnayake and Jayasekera, 2001).

Introduction of propagators would help to increase the temperature, thus increasing the germination rate, root growth and maintain humidity constant (Saramathy and Jayasekera, 2002). But the propagators established on the earth would affect by the temperature fluctuations and rainfall, resulting less heat and drainage problems respectively.

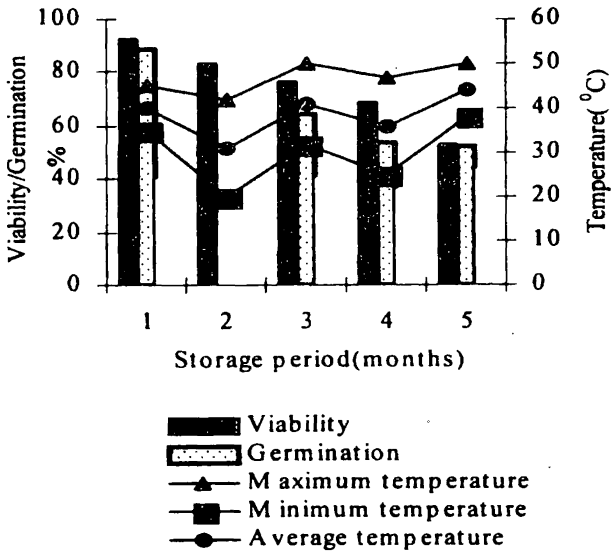

Figure 2. Effect of temperature on viability and germination percentage (Trial 1)

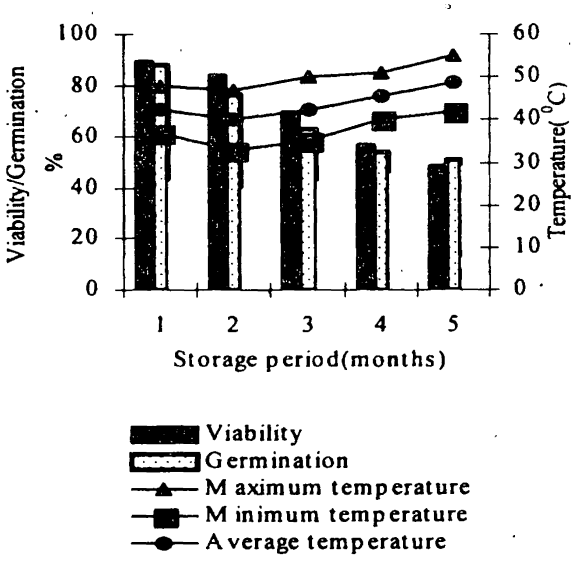

Figure 3. Effect of temperature on viability and germination percentage (Trial 2)

6. *Relationship between Viability and Field Germination Ability of Cashew Seeds*

In both trials, viability and germination percentages were more or less similar in all the storage methods, tested after each storage period. According to the Pearson Rank Correlation Test, a significant correlation (Trial 1: 91.22% and Trial 2: 77.65%) exists between seed viability obtained from the tetrazolium test and the seed germination obtained from the field germination test of cashew (Table 4).

7. *Relationship between Seed Viability and Seedling Vigour of Cashew*

According to the Pearson Rank Correlation Test, there were acceptable relationships exist between seed viability obtained from the tetrazolium test and leaf area in both trials. However, the relationship, between the seed viability and plant height obtained after 3 months of germination is significant only in the second trial. There was no relationship between the seed viability and leaf number counted after 3 months of growth (Table 4). Therefore, seedling vigour cannot be predicted exactly using the tetrazolium test in the above manner.

Table 4. Relationships between viability and germination and viability and seedling vigour

Relationship	PCC	Probability
Trial 1		
V and G	0.9122	0.0001
V and H	0.2404	0.3071
V and LA	0.9030	0.0001
V and LN	-0.0476	0.8421
Trial 2		
V and G	0.7765	0.0001
V and H	0.8169	0.0001
V and LA	0.6874	0.0001
V and LN	-0.2705	0.1909

[Note: PCC= Pearson rank correlation coefficient, V= Seed viability by tetrazolium test, G= Actual seed germination, H= Plant height after 3 months, LA= Leaf area after 3 months, LN= Leaf number after 3 months]

The variation observed in the seedling vigour parameters might be due to seed characters, physiological factors and climatic conditions of the seeds which would affect the seedling growth in the field.

However, the strong relationships observed between the seed viability and some of the seedling vigour parameters suggest the possibilities of using tetrazolium test for predicting seed vigour with some alterations especially in the interpretation of staining patterns.

However, the possibilities of increasing the precision of the test should be investigated in order to introduce a standard tetrazolium test for the determination of seed viability and seedling vigour of cashew. Since these observations were made incubating the kernels under 32^{0}C for 10 hours using 1% TZ solution, it would also add considerable confidence to devising future strategies if furthermore extensive research is carried out to identify an economical way of handling the chemical (by changing the temperature and concentration levels) or to determine an appropriate alternative (For an instance; measuring the electrical conductivity of seeds) which can make an accurate forecast on field germination and seedling vigour of cashew.

CONCLUSIONS

The effect of storage method on germination and seedling vigour is more significant when the period of storage goes up. Thus, it can be concluded that the seeds stored under air tight metallic bins and in sealed polythene bags under 4^{0}C conserves the seed viability effectively during the stored period, resulting higher germination percentage and seedling vigour. Therefore, higher volumes of airtight metallic bins or maintenance of seeds at 4^{0}C in a refrigerator could be recommended for seed storage of cashew.

Higher seed viability observed in the TZ test compared to germination test in the comparative samples may be due to practical difficulties in the field, pathogens or accelerated aged because the sown seed get another half a month or more age old in the field until germination takes place. This can best be controlled using permanent propagators of constant temperature and humidity levels with a sterilized rooting medium and improved drainage facilities.

The results revealed that 2,3,5-triphenyltetrazolium chloride can be used in 1% solution with a staining period of 10 hours at 32^{0}C in dark to predict field germination ability of seeds with 80.31% (P= <0.0001) reliability.

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