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Physiological Changes During Castor Seed Deterioration

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ABSTRACT

Studies were undertaken with freshly harvested genetically pure seeds of castor hybrid YRCH 1 in the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore to study the physiological changes occurring during storage. Before storage, seeds were given dry halogen (3 g and 6 g kg^{-1}) and halo polymer treatment (6 g and 8 g kg^{-1}) respectively. The physiological parameters revealed that the dry halogen treatment had proved to be better in maintaining the physiological quality when compared to untreated seeds and it recorded higher speed of germination (5.05), germination percentage (88 %), shoot length (29.81 cm), root length (15.12 cm), vigour index (3956) and dry matter production (175.8 mg 10 $seedling^{-1}$), respectively over control. With reference to the storage conditions, seeds stored in cold storage maintained seed quality at higher level when compared to ambient storage.

Keywords Castor seeds, Packaging material, Seed quality parameters, Physiological chaeges, Vigour index.

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INTRODUCTION

Castor bean (*Ricinus communis* L.) is a non-edible oil seed crop with enormous significance and it is cultivated around the world because of the commercial importance of its oil. The seeds contain between 40-60% oil that is rich in triglycerides, mainly ricinolein (Deshpande *et al*. 1996). India, China, Brazil and Thailand are the major castor producing countries and India has the largest area (9.47 lakh ha), production (13.79 lakh tones) and highest productivity (1,140 kg ha^{-1}) in the world and it accounts for nearly 59% of the world's castor area and 81% of world castor production. The major castor producing states are Gujarat, Rajasthan and Andhra Pradesh and Gujarat accounts for 78% of India's castor production with about 58% of area and with the highest productivity of 1,679 kg ha^{-1} (SEA 2010). Tamil Nadu covers an area of 13,900 ha with 5,560 tones production and 400 kg ha^{-1} productivity (Anon 2015).

Seed is a basic and decisive input in agriculture. The most important aspect in the seed program is maintaining the continuous supply of high quality

seeds to producers and it is a proven fact that high quality seed responds well for the other inputs and can increase the yield by 10-12%. Although deterioration of seeds can't be controlled, it can however be slowed down to an appreciable extent by adopting suitable technologies viz., methods of storage, storage conditions, containers and seed treatments. Controlled atmosphere storage of seeds is one of the modern approaches to minimize the loss in seed quality by reducing the respiration rate, which results in delayed senescence and better maintenance of seed quality in storage but such facilities are not always available for bulk quantity of crop seeds at all places and also not affordable by the farmers. Many researches have proved that the deterioration sequence can be substantially slowed by equilibrating the seeds with halogen compounds before storage as halogens can readily pass into vapour phase at room temperature and binds to the fatty acid chain, thereby prevents the free radicle formation (Basu and Rudrapal 1980). Hence halogenation is an inexpensive and cost effective storage technology feasible both for large and small scale farmers so that they can be used in improving the seed longevity. In this study iodine (as a component of halo polymer) and Chlorine (as a component of dry halogen treatment) halogens are used. Thus maintenance of high seed quality during storage is of great significance and therefore, an understanding of how best the seeds can be stored under ambient condition and also in cold storage condition at relatively low cost, with minimum deterioration in quality for periods extending over one or more seasons will be of immense importance in the seed industry and for farming community. Based on this, to study the physiological manifestations of seed deterioration during storage.

MATERIALS AND METHODS

Freshly harvested genetically pure seeds of castor hybrid YRCH 1 obtained from Tapioca and Castor Research Station, Yethapur formed the base materials for the storage experiment. Halo polymer was obtained from M/s. Hilton Halopolymer company, Coimbatore and the polymer used was red in color for castor. With a view to realize the objectives enumerated in the introduction, the storage experiments were carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. The seeds were subjected to Iodine impregnated halo polymer @ 6g kg^{-1} of seed, dry halogen seed treatment with Calcium hypochlorite [$Ca(ClO)_2$] @ 3g kg^{-1} of seed along with control. After the seed treatment, seeds were packed in 700 gauge moisture vapour proof bags and stored under ambient and cold storage conditions for six months after the initial evaluation. The seed samples were drawn at monthly intervals up to 6 months of storage and evaluated for the physiological parameters related to seed deterioration under laboratory conditions. The data collected from various experiments were analyzed statistically adopting the procedure described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Moisture content of seed is one of the important factors influencing the storage period. In the present investigation 700 gauge polythene bags was used for storage of castor seeds so that the moisture content was kept constant. Hence, no significant increase in moisture content was noticed in castor due to seed treatments, storage conditions and storage periods.

Seed deterioration is associated with delayed seedling emergence followed by slower rate of seedling growth and development and decreased germination. It is evident from the present study that, halogen seed treatments given to the castor seeds had recorded higher speed of germination (4.70) than the control (3.85). The beneficial effect of halogens had reduced the lipid peroxidation process and hence the deterioration rate. So the food reserves availability would be more that might result in higher speed of germination in castor. With reference to storage conditions, seeds stored in cold storage condition recorded the higher speed of germination however, no significant difference was observed but with the advancement in storage period the speed of germination reduced irrespective of seed treatments and storage conditions and it decreased to 4.15 and the reduction in germination speed might be due to degradation of mitochondrial membrane leading to reduction in energy supply (Gidrol *et al*. 1989). The results were

supported by Gomathi (2009) and Nithya (2012).

The study clearly depicted that treating the castor seeds with dry halogen treatment had improved the germination percentage in comparison to control and the treated seeds recorded higher germination percentage of 5 % at the end of six months of storage (Table 1). The above mentioned data are in conformity with the results obtained in ground nut (Sathiya Narayanan and Prakash 2015 and Jenifer Sandhya 2015). With reference to the storage conditions, seeds stored in cold conditions recorded higher germination than the ambient condition stored seeds and the percentage increase was 1.2 %. Also reported that soybean seeds stored at controlled temperature (15-20^{o}C) had higher per cent germination than the seeds stored at ambient condition and similar opinion was reported by Khalequzzaman *et al*. (2012) and Basavegowda (2013) in chick pea. Over a period of storage, the decline in germination percentage was observed and it decreased by 9 % at the end of six months of storage. Obtained fall outs coincides with the results of Shakuntala (2009) in sunflower.

Reduced seedling growth is a consequence of seed deterioration. In the present investigation, castor seeds given with dry halogen treatment recorded higher seedling growth of 17.4 and 16.8% increased root and shoot growth, respectively over control. Results coincide with that of Shivashankargouda Patil *et al*. (2004) and Ravi Hunje *et al*. (2007). Storage conditions did not cause significant variations in total seedling length but with reference to the storage period, total seedling length decreased irrespective of seed treatments and storage conditions and it reduced from 48.7 cm to 39.02 cm at six months after storage.

Table 1. Effect of halogen seed treatment, storage condition and storage period on germination (%) of castor hybrid YRCH 1 seeds during storage. (Figure in parenthesis indicates arcsine value)**.**

Seed treatment (T)	Storage condition (S)	Period of storage in months (P)							Mean
		P_0	P_1	P_2	P_3	P_4	P_5	P_6	
Control	Ambient storage	90 (71.57)	89 (70.63)	87 (68.87)	86 (68.03)	84 (66.42)	81 (64.15)	78 (62.02)	85 (67.22)
	Cold storage	90 (71.57)	89 (70.63)	89 (70.63)	87 (68.87)	85 (67.22)	83 (65.65)	79 (62.72)	86 (68.03)
	Mean	90 (71.57)	89 (70.63)	88 (69.73)	87 (68.87)	85 (67.22)	82 (64.89)	79 (62.72)	86 (68.03)
Halo polymer (6 g kg^{-1})	Ambient storage	90 (71.57)	90 (71.57)	88 (69.73)	87 (68.87)	85 (67.22)	83 (65.65)	80 (63.43)	86 (68.03)
	Cold storage	90 (71.57)	90 (71.57)	89 (70.63)	88 (69.73)	85 (67.22)	84 (66.42)	81 (64.15)	87 (68.87)
	Mean	90 (71.57)	90 (71.57)	89 (70.63)	88 (69.73)	85 (67.22)	84 (66.42)	81 (64.15)	87 (68.87)
Dry halogen (3 g kg^{-1})	Ambient storage	90 (71.57)	90 (71.57)	89 (70.63)	89 (70.63)	87 (68.87)	86 (68.03)	83 (65.65)	88 (69.73)
	Cold storage	90 (71.57)	90 (71.57)	90 (71.57)	89 (70.63)	88 (69.73)	86 (68.03)	84 (66.42)	88 (69.73)
	Mean	90 (71.57)	90 (71.57)	90 (71.57)	89 (70.63)	88 (69.73)	86 (68.03)	84 (66.42)	88 (69.73)
	Period mean	90 (71.57)	89 (70.63)	89 (70.63)	88 (69.73)	86 (68.03)	84 (66.42)	81 (64.15)	87 (68.87)

	Ambient storage	Cold storage
Storage condition mean	86 (68.03)	87 (68.87)

	T	S	P	T × S	S × P	T × P	T × S × P
SEd	0.489	0.399	0.747	0.692	1.057	1.295	1.832
CD (P=0.05)	0.978**	NS	1.494**	NS	NS	NS	NS

The observation on the quality of the seed made with the dry matter in the present study indicated that the seeds given with dry halogen treatment had recorded higher dry matter production than the control and the percentage increase due to dry halogen treatment was 20.3 mg 10^{-1} seedlings at the end of six months of storage. The above mentioned outcomes are in accordance with the results of Sathiya Narayanan and Prakash (2007) in sunflower. Among the storage conditions, no much variation was found but comparatively seeds stored in cold storage condition performed better than the ambient condition stored seeds and recorded 1.9 mg 10^{-1} seedlings higher dry matter. Over a period of storage, dry matter followed the decreasing trend and it decreased by 69.7 mg 10^{-1} seedlings from initial to six months after storage. This reduction in dry matter may be due to ageing, which resulted in seed deterioration and hence decrease in the germination percentage, seedling length and finally seedling dry weight.

In the present investigation, the vigour potential in terms of vigour index values determined at six months after storage was relatively higher in seedlings of castor (3477) seeds treated with dry halogen treatment than the control (2796) (Table 2). The obtained results are in agreement with Rathinavel and Dharmalingam (2001) in cotton. With respect to seed treatment, the dry halogen treatment recorded the higher vigour index of 24.36% in castor over control. With reference to storage conditions, no significant variations had been found in both the crops but over a period of storage, vigour index followed the negative trend and it decreased from 4383 to 3109 in. This is in agreement with the results of Kapoor *et al*. (2011) in paddy and Oyekale *et al*. (2014) in sesame.

Seed health status should be tested periodically during storage since, the seeds infected by pathogens may drastically affect the quality of seed. In the present study, the seeds were infected with fungi during storage and most of the seeds showed the infection of *Aspergillus* sp. In the present investigation, seeds given with dry halogen treatment recorded 8% lesser pathogen infection than the control 12 % after six months of storage. The antimicrobial property of halogens has been documented by Selvaraju (2001) in rice. With regards to storage conditions, seeds stored in cold storage recorded 3 % lesser pathogen infection than the seeds stored in ambient storage condition. Over a period of storage, the pathogen infection percentage was increased by 7 %. Patra *et al*. (2000) reported that increase in storage period of groundnut seeds upto nine months, the viability decreased, while

Table 2. Effect of halogen seed treatment, storage condition and storage period on vigour index of castor hybrid YRCH 1 seeds during storage**.**

Seed treatment (T)	Storage condition (S)	Period of storage in months (P)							Mean
		P_0	P_1	P_2	P_3	P_4	P_5	P_6	
Control	Ambient storage	4386	4294	3882	3739	3508	3138	2770	3674
	Cold storage	4386	4294	3982	3798	3562	3232	2821	3725
	Mean	4386	4294	3932	3768	3535	3185	2796	3700
Halo polymer	Ambient storage	4365	4359	3929	3795	3635	3435	3028	3792
(6 g kg^{-1})	Cold storage	4365	4363	3978	3839	3644	3514	3082	3826
	Mean	4365	4361	3954	3817	3640	3475	3055	3809
Dry halogen	Ambient storage	4397	4359	3998	3944	3778	3670	3450	3942
(3 g kg^{-1})	Cold storage	4397	4367	4054	3945	3828	3687	3503	3969
	Mean	4397	4363	4026	3945	3803	3679	3477	3956
	Period mean	4383	4339	3971	3843	3659	3446	3109	3822

Storage condition mean	Ambient storage 3803	Cold storage 3840

	T	S	P	T × S	S × P	T × P	T × S × P
SEd	61.79	50.45	94.38	87.38	133.48	163.48	231.19
CD (P=0.05)	123.58**	NS	188.79**	NS	NS	NS	NS

pathogen activity, moisture and sugar content in seeds increased gradually. It is evident from the present study that the untreated seeds and the seeds stored in ambient condition recorded higher pathogen infection and that leads to faster deterioration while the seeds treated with the halogens and stored in cold storage had minimal fungal infection there by maintaining the seeds with better health status.

CONCLUSION

The study clearly depicted that by storing the castor seeds in 700 gauge polythene bags, the seeds can be safely stored for six months even without imposing any seed treatment as it meet with standards of IMSCS. On the other hand, treating castor with dry halogen and storing in cold condition had maintained the seed quality at higher level over a period of storage by subduing the deterioration process hence the storability can be prolonged.

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