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RESEARCH ARTICLE

An Approach to Develop Economically Beneficial Technique for Storage of Seeds

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Abstract

Black gram or Urd bean is a widely cultivated pulse crop in India in different seasons and then stored for further use. In our area, seeds get deteriorated in storage during monsoon season resulting in infestation due to high humidity and temperature leading to great losses. So keeping this idea in mind, the present experiment was planned to study the effect of different concentrations of extract from latex-yielding plant i.e. *Calotropis procera* on various parameters of germination. *Calotropis procera* is a perennial drought enduring shrub commonly found in Northern India and belongs to family Asclepiadaceae. This plant possesses a milky latex which helps in retaining water and plugging the areas of injury. The latex is a viscous fluid which is an emulsion or suspension of proteins, sugars, gums, enzymes, essential oils, resins and waxes. Effect of different extract concentrations on germination of black gram (*Vigna mungo* (L.) Hepper) seeds were evaluated by subjecting the seed lots to different moisture levels (12, 10, 8 and 6%) to accelerating ageing. Seed deterioration in terms of loss of viability was less in all the seed lots treated with various extract concentrations. Application of extract had a positive effect mainly at concentration 40-100% over control in response to accelerated ageing conditions of storage.

Keywords: Black gram, *Calotropis procera*, germination, seed storage, accelerated aging.

Introduction

Seed is a basic input in modern agriculture. A farmer's entire crop depends on the quality of seed he sows. Therefore, it is necessary to plant good quality seed. In many parts of the world, farmers save a portion of their harvest for sowing in the next season. This has been the practice in India also. But in our country where temperature remains high most of the time and relative humidity is also more during rainy season, seed storage without deterioration under ambient conditions is problematic. High temperature and high humidity hasten the ageing process of seeds resulting in considerable loss of seed vigour, viability and yield potential of crop (Kapri *et al.,* 2003). The main purpose of seed storage is to maintain the seed in good physical and physiological conditions from the time they are harvested until the time they are planted. Helmer *et al.* (1962) suggested that a seed reaches to its maximum quality at physiological maturity and thereafter deterioration occur until plantation time. Before progressive ageing which ultimately leads to death of the seed, the accumulated deterioration is likely to affect the potential life processes of the germinating seed and it is reflected in terms of loss of viability and vigour. In India, the black gram or urd bean (*Vigna mungo*) is widely cultivated throughout the plains and up to 1820 m elevations. This crop is grown in three different seasons in India i.e. rainy (kharif), winter (rabi) and spring and summer (zaid). In general, this crop is grown in rainfed condition during rainy season and on residual moisture in winter season in eastern and southern parts of country. In spring season, this is cultivated after the harvest of Indian rape (*Brassica napus*) and potato (*Solanum tuberosum*) in northern India. It is also grown in Pakistan, Bangladesh, Sri Lanka and Myanmar (Singh and Ahlawat, 2005). Seed moisture and storage temperature are the two most important factors influencing loss of viability during storage. The status of water and its binding in relation to seed moisture determine its storage behavior. Also, seeds are sensitive to imbibitional stress, which is controlled by three factors, namely, the temperature of the medium, the initial moisture content of the seed and the rate at which water is taken up (Pollock, 1996). The interaction of these factors has a dramatic effect on subsequent seed viability and vigour (Dickie and Smith, 1995). However, reducing the seed moisture and then subsequent storage in moisture impermeable containers can extend their longevity. Therefore, a study was undertaken to explain the viability of urd bean seeds conditioned to various extract concentrations on the basis of seed moisture characteristics.

Materials and methods

Collection of urd bean seeds: The urd bean seeds for the study were collected from Agriculture Research Station, Sriganganagar, Rajasthan, India.

Treatments: Freshly harvested seeds of urd bean were selected for present investigation. Four sets of seed samples were made.

Table 1. Effect of moisture content, time period and treatment (*Calotropis* extract) on germination % of seeds of blackgram.

Set (s)	Time period (Days)	Treatment concentration												Mean
		Control	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
Set 1 moisture content (12%)	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	30	75.0	75.0	75.0	75.0	77.0	80.0	80.0	84.0	84.0	90.0	96.0	96.0	82.3
	45	58.0	58.0	58.0	62.0	67.0	67.0	70.0	77.0	77.0	84.0	90.0	90.0	71.5
	60	37.0	37.0	40.0	41.0	41.0	47.0	56.0	72.0	74.0	76.0	76.0	74.0	55.9
Mean		74.0	74.0	74.6	75.6	77.0	78.8	81.2	86.6	87.0	90.0	92.4	92.0	81.9
Set 2 moisture content (10%)	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	30	72.0	72.0	74.3	74.3	76.0	78.0	78.0	80.0	80.0	80.0	80.0	80.0	77.1
	45	60.0	60.0	62.0	64.0	64.0	67.0	67.0	70.0	71.3	73.0	73.0	73.0	67.0
	60	39.0	40.0	40.0	45.0	45.0	47.0	50.0	50.0	57.3	61.0	61.0	61.0	49.7
Mean		74.2	74.4	75.3	76.7	77.0	78.4	79.0	80.0	81.7	82.8	82.8	82.8	78.6
Set 3 moisture content (8%)	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	30	72.0	72.0	72.0	73.0	73.0	77.0	78.0	84.0	87.0	87.0	87.0	87.0	79.1
	45	60.0	60.0	60.0	61.0	61.0	65.0	67.0	71.0	76.0	76.0	76.0	76.0	67.4
	60	39.0	39.0	39.0	40.0	40.0	43.0	45.0	49.0	57.0	57.0	57.0	57.0	46.8
Mean		74.2	74.2	74.2	74.8	74.8	77.0	78.0	80.8	84.0	84.0	84.0	84.0	78.7
Set 4 moisture content (6%)	0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	30	72.0	72.0	72.0	73.0	73.0	77.0	78.0	84.0	87.0	87.0	87.0	87.0	79.1
	45	60.0	60.0	60.0	61.0	61.0	65.0	67.0	71.0	76.0	76.0	76.0	76.0	67.4
	60	39.0	39.0	39.0	40.0	40.0	43.0	45.0	49.0	57.0	57.0	57.0	57.0	46.8
Mean		74.2	74.4	75.3	76.7	77.0	78.4	79.0	80.0	81.7	82.8	82.8	82.8	78.6
Grand Mean		74.1	74.2	74.5	75.5	75.9	77.8	79.0	82.0	84.2	85.2	85.8	85.7	79.5
	Set		Time		Treatment		Set*Time		Set* Treatment		Time* Treatment		Set* Time * Treatment	
C.D. P=0.05	0.16		0.32		0.21		0.36		0.56		0.72		1.25	

Set 1: Seeds with moisture content 12%
Set 2: Seeds with moisture content 10%
Set 3: Seeds with moisture content 8%
Set 4: Seeds with moisture content 6%
All the seed samples were treated with extract taken from latex-yielding plant i.e. *Calotropis procera*. For the preparation of extract of this plant, fresh leaves were taken and washed in water thoroughly. These leaves were crushed with the help of juicer/mixer and the extract was collected in the conical flask. Then all the seed samples were soaked in different percentage of extracts like 5, 10, 20 to 100% for 30 min separately and were labeled as T2-T12. Different concentrations were prepared in water. Seeds without treatment served as control and were labeled as T1. Thereafter, seeds were air dried to their respective moisture contents i.e. 12, 10, 8 and 6%. Their moisture content was measured by Moisture Meter. Then all seed samples were stored in polythene bags separately and properly sealed.

Accelerated ageing: Seeds were put in wire mesh baskets in single layers and incubated at 40±1^{o}C and 80% relative humidity for 60 d in desiccators with distilled water at the bottom. Periodical samples were drawn at 0, 15, 30, 45 and 60 d interval and observations on seed moisture and germination were recorded. The laboratory tests were conducted in three replicates each time. Germination tests were carried out as per the rules of ISTA (1993).

Statistical analysis: Each set was studied for the effect of storage time period and extract treatment (alone and as interaction) in 3 way ANOVA (Factorial CRD). Assumptions of normal distribution and homogeneous variance were tested by the Kolmogrov-Smirnov test and Cochran's C test respectively. For determining significant differences between treatments, Critical Difference (C.D.) was used. All statistical analyses were done following Chandel (2004).

Results and discussion

In the initial stages of ageing, the germination percent was almost same in control as well as in case of all treated seeds in all the four sets. But with progressive ageing, there was a sharp decrease in germination percent (Table 1). The treatments T2-T5 (5-30%) showed less difference but treatment between T6-T12 (40-100%) promoted germination percent with respect to control during the process of ageing (Table 1). The ageing till 15 d did not affect percent germination but showed significant reduction as ageing progressed from 15-60 d (Table 1). Delouche and Baskin (1973) have developed accelerated ageing test for evaluating relative storability of seed lots as it is a good predictor of seed vigour and field performance as they both decline with age. More or less similar trends of results were recorded in all the four sets at all concentration of extracts as shown in Table 1.

The treatments T2-T5 (5-30%) showed almost same and had less difference with untreated seeds. The effect of extract at doses T6-T12 (40-100%) was more and there was significant improvement in germination percent over control in response to accelerated ageing conditions of storage. These observations are in support with studies in Okra (Nagarajan *et al.,* 2004). From the above results, it is indicated that besides, the role of cell membranes in limiting the loss of intracellular components, they also bound the intracellular compartments and organelles. Any delay or obstruction of membrane reorganization during imbibition would allow mixing of substances normally segregated from one another by membranes in the hydrated cell. The direct result could be loss of metabolites, inability to maintain electric, chemical or pH gradients and a mixing of normally separated cellular constituents. An indirect result would be loss of vigour. At the ultrastructural level, Harman and Granett (1972) have reported that aged pea seeds show evidence of damage to mitochondria and the plasma membrane. A decline in oxygen consumption with ageing has also been reported by a number of scientists (Byrd and Delouche 1971; Woodstock, 1973). Respiration within mitochondrion is a function of 'unit membranes' and loss of membrane integrity would presumably alter the functional relationships of the membrane bound components of the respiratory chain. Some workers have suggested that mitochondria of aged seeds are progressively uncoupled (Abu Shakra and Ching, 1967) which could easily be reconciled with loss of membrane integrity, especially if the trans-membrane proton gradient or electron motive force is crucial for coupling. There are certain plant products which influence the biological attributes of other plants. Sengupta *et al.* (2001) have reported that seed plus which is a naturally derived biostimulant increased the growth and productivity of green gram crop by 28-65% over the control treatment. These findings are very much similar with our results. Accelerated ageing affected the general inhibition of metabolism in seeds during storage, resulting in decreased germination. It is noteworthy that higher concentration of the extract is seen to be effective in controlling some losses caused by high moisture and temperature conditions.

Conclusion

Ageing is a universal physiological phenomenon occurring in living organisms. It is generally at a faster rate under stress of unfavourable environment. From time to time, several workers tried various approaches to slow down this process in different plant species. Reports on pulses are however, scanty on this aspect (Singh and Yadav, 1987). So seeds of black gram were selected for investigation. In the present study, storage of treated seeds in air limited conditions i.e. sealed polythene bags under accelerated ageing conditions have been found to be quite effective in maintaining parameters of germination with respect to control.

During air limited storage, oxygen in sealed containers is depleted due to respiration. It is replaced by carbon dioxide which slowed down the metabolic activities in seeds. Urd bean seeds conditioned to various extract concentrations showed better viability at lower as well as at higher seed moisture content during storage. The extract treatments nullified the effect of seed moisture content. Thus, by using this technique, one can increase the quality of seeds in storage. So, it is suggested that storage conditions and seed treatments should be designed in such a way that they can prolong the health of seed by reducing or limiting the factors that impairs viability. The general storage conditions and seed treatments should therefore aim at reducing the metabolism of seeds through lowering the temperature, humidity and packing of seeds in moisture proof containers.

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