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Research Article

STUDIES ON SEED VIABILITY, GERMINATION AND SEEDLING VIGOUR IN KARONDA

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ABSTRACT

The studies on seed viability, germination and seedling growth of karonda seeds were carried out at the nursery of department of Horticulture, Khalsa College Amritsar during the year of 2018-2019. In the trial seeds of karonda were collected and sown according to the seven treatments viz., zero days of extraction, 12 days of extraction, 24 days of extraction, 36 days of extraction, 48 days of extraction, 60 days of extraction and 72 days of extraction with three replications. The investigation was laid out in Randomized Block Design. The results of the study revealed that the seed germination was significantly the highest (63.32%), when fresh seeds were sown. The seedling height , number of leaves, fresh and dry weight of shoots, root number and vigour index varied with the storage period of seeds. The seeds sown at zero days of extraction gave 50 percent germination in 10.33 days and completion of germination in 20.34 days. After 12 days of extraction it took 13.33 days and 26.00 days for 50 percent germination and completion of germination respectively. The seeds sown after 12 days of extraction (12 days stored seeds) upheld good germination and seedling vigour therefore, karonda seeds could be stored for 12 days after extraction from fruits at ambient condition with good seed viability and vigour.

INTRODUCTION

Karonda (*Carrisa carandas* Linn.) is an important minor edible underexploited fruit crop of India (Bhavya *et al* 2017). It belongs to family Apocynaceae and is commonly known as Karonda in India, Bengal currant or Christ's thorn in South India (Imran *et al* 2012). It is found wild in Bihar, West Bengal, South India and as commercial plantations in Varanasi district of Uttar Pradesh. *Carrisa* species is of much socio-economic importance in the tribal areas of Gujarat, Rajasthan and Madhya Pradesh. A great beauty of plant is that its leaves are shining and ornamental and it bears flowers and fruits almost throughout the year (Banik *et al* 2012). The sweeter fruits of karonda may be eaten raw but the more acid ones are best stewed with plenty of sugar. The ripe fruits contains high amount of pectin therefore it is also used in making jelly, jam, squash, syrup, tarts and chutney, which are of great demand in international market(Yadav *et al* 2018). The taste of fruits is extremely sour and is made delicious by pickled with hot green chilies and garlic clove, both ingredients are packed with health benefits and increase the taste of the pickle. Besides preserves, the fresh fruits can be cooked as vegetable and in market a preserved product that closely resembles canned cherry fruits is sold in south part of India by the product "Nakal Cherry" which forms a good substitute for canned fruits of real sweet cherry which is exported to other countries particularly to Bangladesh (Dey *et al* 2017). They are eaten raw and also used for making good quality coloured wine. The unripe fruits yield milky white latex which can be used in preparing chewing gum and rubber (Kumar *et al* 2007). Karonda is rich in nutrients, vitamins and minerals such as proteins, carbohydrates, calcium, iron, carotene, vitamin B_1, B_2, etc. Being a rich source of vitamin C, sometimes they contain more ascorbic acid than an average orange. The fruits are useful as an auxiliary in tanning and dyeing and for medicinal purposes. The leaves of karonda can be used as fodder for tusser silk worm. The unripe fruit is sour, astringent, bitter, thermogenic, constipating, anaphrodisiac, antipyretic, and useful in vitiated conditions of *pitta* and *kapha*, hyperdipsia, diarrhoea, anorexia and intermittent fevers. The ripe fruit is sweet, cooling, appetiser and antiscorbutic and is useful in burning sensation, skin diseases, scabies, pruritus. The roots are anthelmintic, stomachic and antiscorbutic and are useful in stomach disorders, intestinal worms, scabies and pruritus(Dey *et al* 2017). Decoction of its leaves is also used against fever, diarrhoea and ear ache, and the roots are used for stomachic, vermifuge, remedy for itches, and insect repellent(Yadav *et al* 2018; Singh and Uppal 2015). Leaf extract is externally applied for curing leprosy. Two drops of plant oil is given with half cup of honey for controlling worms of minors(Trivedi 2007). In spite of a great demand of quality planting material of karonda

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seedlings a limited work has been done on its propagation and a very little information is available regarding literature on germination and storage of karonda seeds.

MATERIALS AND METHODS

The present investigation was carried out during the year 2018-2019 at the nursery of Department of Horticulture, Khalsa College, Amritsar. The whole experiment comprised of 7 treatments T_1 (0 days of extraction), T_2(12 days of extraction), T_3(24 days of extraction), T_4(36 days of extraction), T_5(48 days of extraction), T_6(60 days of extraction), T_7(72 days of extraction), which were replicated thrice in Randomized Block Design. The fully ripened karonda fruits were collected from the karonda plants grown in the College house of Khalsa College, Amritsar in the month of August . The seeds were washed with water to remove the mucilaginous covering over the seed surface. Freshly extracted hundred (100) seeds were sown in polybags containing potting mixture immediately after extraction. For further studies the seeds were shade dried. The required seeds were treated with fungicide Bavistin and kept in butter paper bags and stored at ambient temperature except first treatment where seeds were sown immediately after extraction. These stored seeds were taken for further seed germination studies. On 12, 24, 36, 48, 60 and 70th day hundred seeds per treatment were soaked in water for overnight and were sown in polybags containing potting mixture after overnight soaking in water. Seeds were sown treatment wise in polythene bags containing potting mixture at 1-1.5cm depth. The potting mixture was moistened before sowing and watering was done regularly as and when the top 2 cm media got dried. Weeding and watering were done at regular intervals whenever needed. The medium was drenched with carbendazim (0.15%) at fortnightly intervals to check disease incidence. The observations regarding days taken for initiation of germination, 50% germination, complete germination, germination percentage (%) and vigour index were taken at regular intervals.

RESULTS AND DISCUSSION

Days taken for Initiation of Germination

According to the data the seeds sown at zero days of extraction (T_1) recorded minimum number of days taken for initiation of germination (8.33 days). The maximum number of days required for initiation of germination (14.00 days) were observed for seeds sown at 60 days after extraction (T_6). The fact clearly established in the outcome of results was that there existed a consequential increase in germination time with an advancement of seed storage period from zero days of extraction to 72 days of extraction. This could be attributed to the seed deterioration during storage, leading to reduction in vigour, germination rate, enzymatic activity, respiration, increase in permeability and susceptibility in stresses, decrease in seedling growth rate, reproductive processes and yield as reported by Verma *et al* (2003). This also might be due to the oxidative enzymes essential for conversion of stored food reserves of seed into simpler substances and for translocation of these simpler substances into the embryo for emergence of radical and plumule and thereby promoting the rapid germination. These results are also in accordance with Yalleshkumar *et al* (2007) in Mango, Abbas *et al* (2003) in jamun, Deepika (2013), Deepika and Vanajalatha (2016) in karonda.

Table 1 Effect of period of seed storage on days taken for germination of karonda

Treatments	Days taken for initiation of germination	Days taken for 50% germination
T_1 zero days of extraction	8.33	10.33
T_2 12 days of extraction	8.66	13.33
T_3 24 days of extraction	9.67	17.67
T_4 36 days of extraction	12.66	20.65
T_5 48 days of extraction	13.00	21.67
T_6 60 days of extraction	14.00	22.00
T_7 72 days of extraction	13.66	22.66
Mean	11.51	18.33
CD	1.56	1.01

Days taken for 50% Germination

According to the results minimum days (10.33) taken for 50 per cent germination were registered in karonda seeds when sown at zero days of extraction (T_1) whereas maximum days (22.66) taken for completion of 50 per cent germination were recorded when sowing was done after 72 days of extraction (T_7). It was clear from the results that the 50% germination of seeds was reduced considerably with delay in sowing of seeds after removal from the fruit. This might be attributed to the loss of moisture from the seed during storage as compared to the freshly harvested seeds. These results are in accordance with the results of (Abbas *et al* 2003) in jamun. Similar results were found by Yalleshkumar *et al* (2007) in Mango, Tubic *et al* (2010) in oil crops, Vinayachandra and Chadrashekar (2011) and Deepika and Vanajalatha (2016) in karonda.

Days taken for Complete Germination

The perusal of the data on days taken for complete germination as influenced by period of seed storage clearly indicated thatseeds sown at zero days of extraction had taken minimum (20.34 days) number of days for completion of germination while maximum number of days(33.00) were taken for completion of germination in T_7 when sowing was done at 72 days after extraction . It has been seen throughout the study that freshly extracted seeds took minimum days for complete germination followed by seeds sown after 12 days of extraction i.e. T_2 and it was maximum in seeds sown after 72 days of extraction. It might be due to the dessication of seeds with the advancement of storage period. These results are in close conformity with the findings of Vinayachandra and Chandrashekar (2011) who reported that the time required for maximum germination also increased with the period of desiccation. Due to the reduction in the moisture content of seed to the critical level, the germination percentage decreased which extended the germination period. Delayed germination led to the loss of seed vigour (Prasad *et al* 1996). On other hand during course of storage, the endogenous GA_3 content of the seeds might have reduced considerably and resulted in poor as well as delayed germination (Rajmanikam *et al* 2002). It is also connected with the higher moisture level in seeds which maintains connection among seed membrane contents and prevents from damage. With the initiation of desiccation, seed contents and membranes start to squeeze under water loss pressure due to which membrane gets damaged. Similar results have been reported by Abbas *et al* (2003) in jamun, Maara *et al*

*(*2006) in Carissa species, Kumar *et al* (2007) in mango and Deepika and Vanajalatha (2016) in karonda.

Germination percentage (%)

The perusal of the data pertaining to germination percentage as influenced by period of seed storage revealed that the seed germination decreased with an increase in seed storage period. Seeds sown at zero days of extraction (T_1) recorded significantly maximum germination (63.32%) and the lowest germination percentage (17.00%) was recorded in T_7 when the seeds were sown on72 days after extraction. The reasons for the germination might be attributed to the fact that recently harvested seeds showed maximum germination percentage that declined with the passage of time during storage. The highest germination percentage of fresh seeds might be due to the availability of adequate moisture content and absence of dormancy. (Pangou *et al* 2011). Various internal as well as external factors are responsible for affecting the viability of the seeds during storage. Under hot, dry conditions, seeds lose viability rapidly as a result of water loss from the endosperm. The decline in per cent germination with advance in storage period might be attributed to the phenomenon of aging, depletion of food reserves, decline in synthetic activity, cytoplasmic or physiological changes in subcellular system (membrane, mitochondria, protein synthesis, ribosomes and DNA) and enzyme machinery during storage with preceeding age of the seed resulting in slow germination rate of embryo, which intended to continue its ontogenetic effect on the developing seedling (Nair 1966). The present studies are also in accordance with the research findings of Tewari and Bajpai (2008) in lasoda, Merlin and Palanisamy (2000) in jackfruit, Tubic *et al* (2010) in soyabean, Smitha (2008) in various minor fruits, Deepika and Vanajalatha (2016).

Table 2 Effect of period of seed storage on days taken for germination and germination (%) of karonda

Treatments	Days taken for completion of germination	Germination percentage
T_1 zero days of extraction	20.34	63.32
T_2 12 days of extraction	26.00	52.33
T_3 24 days of extraction	27.33	43.00
T_4 36 days of extraction	28.32	35.67
T_5 48 days of extraction	29.00	28.34
T_6 60 days of extraction	32.33	22.67
T_7 72 days of extraction	33.00	17.00
Mean	28.04	34.23
CD	4.58	4.40

Seedling vigour index-I (cm)

The data presented clearly signifies that the freshly extracted seeds of T_1 recorded maximum seedling vigour index-1(734.61) and minimum (324.86) in T_7 at 60 days after sowing. After 90 days of sowing (DAS), the vigour index- I was again maximum (2110.59) in freshly harvested seeds i.e.T_1 followed by (1772.64) in the seeds sown after 10 days of extraction i.e. T_2 With the minimum (521.29) in seeds sown after 72 days of extraction i.e. T_7 . Throughout the whole study the vigour index-I was maximum in seeds sown at zero days of extraction i.e. freshly harvested seeds and it decreased during prolonged storage period. The reason for loss of vigour might be the rapid depletion of the carbohydrates and protein reserves in the seeds. These results were also in line with the research study of Dhakal and Pandey (2001) in Niger. This might also be due to the decreased mobilization of reserve substances during germination of the stored seeds (Deepika 2013). The studies on vigour index-I indicated that the freshly harvested seeds were more vigorous at all durations of storage, than the remaining seed lots (Kalsa *et al* 2011). The various research workers observed that the loss of seed vigour was associated with the biochemical deterioration during seed ageing. The seed eventually lose their viability or germinability with the advancement of storage leading to decrease in physiological quality in terms of emergence, rate of emergence and vigour. Seedling growth rate traits by aging may cause loss of membrane integrity due to lipid peroxidation (Eisvand *et al* 2010). Decrease in the activity of enzyme system during storage of seed cause decline of seed vigour. These results are also supported by Singh and Rasid (2003) , Verma *et al* (2003), Yalleshkumar *et al* (2007).

Table 3 Effect of seed storage on vigour index-I(cm) of karonda

Treatments	30days	60days	90days
T_1 zero days of extraction	734.61	1377.94	2110.59
T_2 12 days of extraction	608.28	1125.69	1772.64
T_3 24 days of extraction	442.82	829.40	1293.56
T_4 36 days of extraction	362.56	677.15	1022.20
T_5 48 days of extraction	272.02	533.18	831.35
T_6 60 days of extraction	226.81	430.11	681.59
T_7 72 days of extraction	167.51	324.86	521.29
Mean	402.08	756.90	1176.17
CD	0.67	0.02	0.01

Seedling vigour index-II (g)

Throughout the whole study the freshly harvested seeds i.e. T_1 showed the highest vigour index-II, which declined gradually with the extended period of seed storage. At 30 days after sowing T_1 recorded the maximum vigour index- II (2.75). At 60 days after sowing same trend of increase in vigour index-II in T_1 (11.88) was observed followed by T_2 (8.28). The lowest value was observed in T_7 (1.63). In case of 90 days after sowing T_1 (43.81) maintained more vigour and minimum vigour index-II (5.95) was recorded in T_7. There was a gradual decline in seedling vigour index-II with progressive increase in seed storage period after seed extraction. It is clear from the study that the seeds sown at zero days of extraction were more vigorous than other storage days . The present results are in line with the research findings of Kalsa *et al* (2011), Makawi and Gastel (2006) in different varieties of lentil (*Lens Culinaris* Medikus). The loss of vigour and viability in aged seeds might be associated with the enhanced lipid peroxidation and depressed metabolic system which limits the damage from free radical and peroxide which induces the potential to damage membranes, enzymes and nucleic acids, and likely to be one of the major causes of deterioration of stored seeds(Gowda *et al* 2011). The present results are also in accordance with Vanitha *et al* (2005), Priya and Rao (2008). Deepika (2013) also reported the same in karonda.

Table 4 Effect of seed storage on vigour index-II(g) of karonda

Treatments	30days	60days	90days
T_1 zero days of extraction	2.75	11.88	43.81
T_2 12 days of extraction	2.23	8.28	33.56
T_3 24 days of extraction	1.53	5.14	20.12
T_4 36 days of extraction	1.24	3.68	15.24
T_5 48 days of extraction	0.84	2.77	10.65
T_6 60 days of extraction	0.60	2.26	7.96
T_7 72 days of extraction	0.41	1.63	5.95
Mean	1.37	5.09	19.61
CD	0.015	0.013	0.026

CONCLUSION

From the whole study on seed germination in karonda it can be concluded that the fresh seeds recorded maximum germination and produced vigorous seedlings which declined with the storage period giving minimum results in T_7 (seeds sown after 72 days of extraction). However, seeds sown after 12 days of extraction maintained good vigour than other stored seeds. Hence karonda seeds can be used for propagation after storage at ambient conditions for 12 days after extraction without much variation in growth parameters.

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