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# Effect of seed age and storage conditions on germination, seedling growth and vigour of karonda (*Carissa carandas* L.)

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**Abstract**
The present experiment was carried out to study the "Effect of seed age and storage conditions on germination, seedling growth and vigour of karonda (*Carissa carandas* L.)" during the year 2022-23. The study was conducted with two factors namely, storage conditions [room temperature (25-30 ℃) and Refrigerator (4-5 ℃)] and days after extraction (0, 15, 30, 45, 60, 75 and 90). And observations were recorded till 4 months at monthly intervals. The treatment combination $T_8$ (zero days after extraction + refrigerator storage) recorded minimum no. of days for initiation of germination (7.33 days), maximum germination percentage (89.99%) and growth parameters like highest plant height (3.49, 6.83, 10.84 and 14.98 cm), number of leaves per seedling (6.08, 15.81, 32.41 and 50.91), root length (7.89, 14.70, 20.87 and 30.86 cm) and vigour index I (1024.08, 1937.48, 2853.58 and 4125.14) at 30, 60, 90 and 120 DAS respectively compared to other treatments.

**Keywords:** Karonda, storage condition, refrigerator, seed age, zero days after extraction

## Introduction
Karonda (*Carissa carandas* Linn.), a member of Apocynaceae family is commonly called as "karaunda" or "christ's thorn" or "Bengal currant" in India (Imran *et al.*, 2012) [8]. It is native to India and grows as a wild shrub in Rajasthan, Maharashtra, West Bengal, Bihar and Uttar Pradesh. Karonda is a very hardy and drought-tolerant plant which has potential for being an efficient bio-fence due to the presence of axiliary spines. The juvenile plants can also be used in the making of beautiful ornamental hedges. (Sharma and Banyal, 2010) [15]. Karonda being a woody, evergreen spiny shrub has excellent potential for cultivation in marginal and wastelands. The profuse branching in Karonda roots helps in binding the soil and minimises soil erosion. The dried fruits of karonda may become a substitute for raisins and the syruped berries are mostly used in confectionery. It is rich source of iron (39.10 mg 100 $g^{-1}$) and carbohydrates (67.10 mg 100 $g^{-1}$ edible portion).
Karonda can be propagated by both seeds and vegetative propagation. However, the recalcitrant nature of the seeds poses a limitation for the sexual propagation as the seeds lose viability after extraction due to dessication. Hence, it is very much important to enhance the germination per cent and to know the viable period for seed germination so that, the availability of viable seeds can be extended by proper storage in congenial temperature for future multiplication. Being, a minor fruit crop, very limited work is done in this crop. As it is having short viable period and for extending the availability of viable seeds through for multiplication of planting material by proper storage, Henceforth, the present investigation was carried out with an objective to study the effect of seed age and storage conditions on seed germination and seedling growth.

## Material and Methods
The present experiment "Effect of seed age and storage conditions on germination, seedling growth and vigour of karonda (*Carissa carandas* L.)" was carried out at College of Horticulture, Venkataramannagudem, Dr. Y.S.R. Horticultural University, West Godavari District. The experiment was laid out in factorial RBD with two factors at different levels each replicated thrice. The first factor has two levels *i.e.* room temperature storage and refrigerator storage while the second factor has 7 levels *viz.*, 0, 15, 30, 45, 60, 75 and 90 days after seed extraction. The fully ripe fruits were collected and the pulp was removed.

The seeds were washed thoroughly with running tap water and then shade dried. Seeds were treated with carbendazim @ 1 g $kg^{-1}$ of seed. The treated seeds were kept in butter paper bags and stored in two environmental conditions *viz.*, refrigerator (4-5 ℃) and at room temperature (25-30 ℃). For $T_1$ treatment combination, the seeds were sown immediately after extraction while for $T_8$ treatment combination, the seeds were stored for 6-8 hours in refrigerator prior to sowing. For other treatments, the seeds were stored under refrigerator and room temperature conditions and sown at 15 days interval. Observations were recorded for germination parameters and growth parameters like plant height, number of leaves, root length and vigour index were recorded at monthly intervals upto 4 months.

$$\text{Germination (\%)} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

## Results and Discussion

Data was recorded for germination and growth parameters at regular intervals by selecting five plants randomly.

### Days taken for initiation of seed germination

Seeds sown at zero days after extraction + refrigerated condition ($S_2D_1$) took less time for initiation of germination (7.33 days) whereas seeds sown at 60 days after extraction + room condition ($S_1D_5$) took more time for initiation of germination (24.66 days). This might be due to deterioration of seed at the time of storage, that leading to decline in germination, vigour, respiration rate, activity of enzymes and enhanced permeability and susceptibility to stresses, decrease in growth rate of seedling as reported by Verma *et al.* (2003) [17]. The inhibitory substances especially abscisic acid was removed by low temperature for seed germination and preserves the vitality and the activity of seeds and also preserves their moisture and nutrient reserves that helps for the growth and exposure of embryo parts thus leading to rapid germination (Abdullah, 2003) [1].

### Germination percentage (%)

Maximum per cent of germination (89.99%) was recorded with interaction effect of zero days after extraction + refrigerator ($S_2D_1$) followed by $S_1D_1$ (86.66%) whereas minimum per cent of germination (17.77%) was recorded in 60 days after extraction + room conditions ($S_1D_5$). The highest germination per cent from freshly extracted seeds might be due to activities of ά-amylase and high moisture content and no dormancy, even a slight reduction in seed moisture will leads to significant decrease in germination (Pangou *et al*., 2011) [13]. These observations were in line with the findings of Merlin and Palanisamy (2000) [12] in jackfruit. Low temperature influences the balance of germination promoting (GA) and the germination inhibiting phytohormones (ABA). Increased production of germination promoting hormones by low temperature and thereby shifting the balance between promotors and inhibitors towards the growth promotors (Erker, 2010 and Rehman and Park, 2000) [6, 14].

### Plant height (cm)

Seeds sown from zero days after extraction + refrigerator ($S_2D_1$) recorded highest plant height (3.49, 6.83, 10.84 and 14.98 cm at 30, 60, 90 and 120 days after sowing) whereas lowest plant height (2.48, 4.75, 7.85 and 10.20 cm at 30, 60, 90 and 120 days after sowing) was recorded in seeds sown from 60 days after extraction + room conditions ($S_1D_5$). Plant height was decreased by aging. This could be due to reduced mobilization of the food reserves at the time of germination of stored seeds (Dhakal and Pandey, 2001) [5]. Due to low temperature the increase in gibberellins resulted in promoting elongation of stem through cell division and elongation of internodes in the higher plants (Hopkins and Huner, 2004) [7].

### Number of leaves per seedling

The combination of seed sowing from zero days after extraction + refrigerator condition ($S_2D_1$) recorded the highest number of leaves (6.08, 15.81, 32.41 and 50.91 at 30 to 120 DAS) whereas lowest no. of leaves (4.41, 12.50, 19.78 and 34.63 at 30 to 120 DAS, respectively) was recorded in 60 days after extraction + room condition ($S_1D_5$). Production of more number of leaves under certain storage days might be related to the vigorous growth, which in turn helps them better harvest of sunlight by the plants to produce more number of leaves (Yalleshkumar *et al*., 2018) [18]. These results were supported by Deepika *et al*. (2014) [4] in karonda. Due to storage of seeds at low temperature mobilization of carbohydrate reserves takes place by the hydrolysis of starch which stimulates the development of leaves during germination (Langens-gerrits *et al.*, 2003) [11].

### Root length (cm)

The maximum length of root was obtained with interaction effect of zero days after extraction + refrigerator condition ($S_2D_1$) showed highest root length (7.89, 14.70, 20.87 and 30.86 cm at 30, 60, 90 and 120 DAS, respectively) and lowest root length (5.97, 11.40, 17.82 and 25.12 cm at 30, 60, 90 and 120 DAS, respectively) was observed from 60 days after extraction + room temperature ($S_1D_5$). It might be due to reason that the shoot growth resulted in the production of photosynthates and their translocation to the root zone through phloem which was responsible for increase in root length (Lamichhane *et al*., 2016) [10]. These observations are in conformity with findings of Yalleshkumar *et al*. (2018) [18] in jamun. Cell division and existing cell elongation was induced due to low temperature of increase in gibberellins which in turn might be contributed to increased root length. These observations were supported by Bhavya *et al*. (2017) [2] in karonda.

### Seedling vigour index I

The maximum vigour index I (1024.08, 1937.48, 2853.58 and 4125.14 at 30, 60, 90, and 120 DAS, respectively) was observed in zero days after extraction + refrigerator ($S_2D_1$) and lowest seedling vigour index I (150.15, 286.99, 456.16 and 627.64 at 30, 60, 90 and 120 DAS, respectively) was recorded in 60 days after extraction + room temperature ($S_1D_5$). The loss of vigour might be due to rapid depletion of carbohydrate and protein reserves present in the seeds. And also due to decreased mobilization of food reserves during germination of stored seeds (Shrivastava and Knooer, 1974) [16]. Similar results were reported by Kaur and Kaur (2019) [9] in karonda. Clor *et al.*, (1976) [3] stated that the delayed oxidative losses of food reserves in seeds preserving by storage at low temperature therefore, the ability of embryos to produce vigorous seedlings.

**Table 1:** Effect of seed age and storage conditions on days taken for initiation of germination, germination percentage of karonda (*Carissa carandas* L.)

| Treatments | Days taken for initiation of germination | Germination percentage (%) |
|---|---|---|
| $T_1$ | 8.00 | 86.66 |
| $T_2$ | 12.66 | 74.44 |
| $T_3$ | 16.33 | 65.55 |
| $T_4$ | 20.66 | 48.88 |
| $T_5$ | 24.66 | 17.77 |
| $T_6$ | - | 0.00 |
| $T_7$ | - | 0.00 |
| $T_8$ | 7.33 | 89.99 |
| $T_9$ | 8.33 | 83.33 |
| $T_{10}$ | 9.00 | 78.89 |
| $T_{11}$ | 11.33 | 71.10 |
| $T_{12}$ | 13.00 | 64.44 |
| $T_{13}$ | 15.66 | 56.66 |
| $T_{14}$ | 17.00 | 50.00 |
| S.Em± | 0.080 | 0.349 |
| CD @5% | 0.235 | 1.021 |

* "-" indicates no germination was observed.

**Table 2:** Effect of seed age and storage conditions on plant height and number of leaves of karonda (*Carissa carandas* L.)

| Treatments | Plant height (cm) | | | | Number of leaves | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 60 | 90 | 120 | 30 | 60 | 90 | 120 |
| $T_1$ | 3.43 | 6.75 | 10.67 | 14.76 | 6.00 | 15.56 | 31.99 | 50.86 |
| $T_2$ | 3.17 | 5.96 | 10.01 | 13.81 | 5.85 | 14.98 | 31.47 | 47.61 |
| $T_3$ | 3.05 | 5.54 | 9.45 | 12.94 | 5.50 | 13.90 | 28.31 | 43.51 |
| $T_4$ | 2.72 | 5.16 | 8.62 | 11.53 | 5.02 | 13.41 | 21.83 | 39.02 |
| $T_5$ | 2.48 | 4.75 | 7.85 | 10.20 | 4.41 | 12.50 | 19.78 | 34.63 |
| $T_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $T_7$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $T_8$ | 3.49 | 6.83 | 10.84 | 14.98 | 6.08 | 15.81 | 32.41 | 50.91 |
| $T_9$ | 3.22 | 6.35 | 10.55 | 14.02 | 5.98 | 15.32 | 31.72 | 48.03 |
| $T_{10}$ | 3.12 | 5.88 | 9.92 | 13.62 | 5.64 | 14.16 | 29.12 | 45.02 |
| $T_{11}$ | 3.01 | 5.61 | 9.34 | 13.00 | 5.17 | 13.97 | 22.29 | 41.65 |
| $T_{12}$ | 2.70 | 5.32 | 8.83 | 12.58 | 4.96 | 13.02 | 21.83 | 39.26 |
| $T_{13}$ | 2.66 | 5.05 | 8.57 | 11.74 | 4.79 | 12.84 | 20.91 | 37.37 |
| $T_{14}$ | 2.52 | 4.82 | 8.02 | 11.15 | 4.65 | 12.62 | 20.02 | 35.42 |
| S.Em± | 0.013 | 0.025 | 0.041 | 0.056 | 0.023 | 0.060 | 0.122 | 0.190 |
| CD @5% | 0.037 | 0.074 | 0.119 | 0.164 | 0.068 | 0.176 | 0.357 | 0.554 |

**Table 3:** Effect of seed age and storage conditions on root length and vigour index I of karonda (*Carissa carandas* L.)

| Treatments | Root length (cm) | | | | Vigour index I | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 60 | 90 | 120 | 30 | 60 | 90 | 120 |
| $T_1$ | 7.73 | 14.46 | 20.51 | 30.42 | 967.12 | 1838.06 | 2702.06 | 3915.29 |
| $T_2$ | 7.59 | 14.00 | 19.98 | 29.36 | 800.97 | 1485.82 | 2232.46 | 3213.57 |
| $T_3$ | 6.95 | 13.42 | 19.11 | 28.47 | 655.50 | 1242.83 | 1872.11 | 2714.43 |
| $T_4$ | 6.30 | 12.17 | 18.67 | 27.34 | 440.90 | 847.09 | 1333.94 | 1899.97 |
| $T_5$ | 5.97 | 11.40 | 17.82 | 25.12 | 150.15 | 286.99 | 456.16 | 627.64 |
| $T_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $T_7$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $T_8$ | 7.89 | 14.70 | 20.87 | 30.86 | 1024.08 | 1937.48 | 2853.58 | 4125.14 |
| $T_9$ | 7.70 | 14.52 | 20.43 | 30.12 | 909.96 | 1739.10 | 2581.56 | 3678.19 |
| $T_{10}$ | 7.24 | 14.02 | 19.99 | 29.46 | 817.30 | 1569.91 | 2359.60 | 3398.58 |
| $T_{11}$ | 6.81 | 13.46 | 19.09 | 28.53 | 698.20 | 1355.88 | 2021.37 | 2952.78 |
| $T_{12}$ | 6.64 | 12.81 | 18.76 | 27.41 | 601.86 | 1168.30 | 1777.90 | 2576.96 |
| $T_{13}$ | 6.32 | 12.14 | 18.12 | 26.32 | 508.80 | 973.99 | 1512.26 | 2156.48 |
| $T_{14}$ | 6.06 | 11.62 | 17.93 | 25.59 | 429.00 | 822.00 | 1297.50 | 1837.00 |
| S.Em± | 0.030 | 0.057 | 0.082 | 0.120 | 3.92 | 7.40 | 10.91 | 15.79 |
| CD @5% | 0.087 | 0.166 | 0.239 | 0.351 | 11.43 | 21.65 | 31.89 | 46.16 |

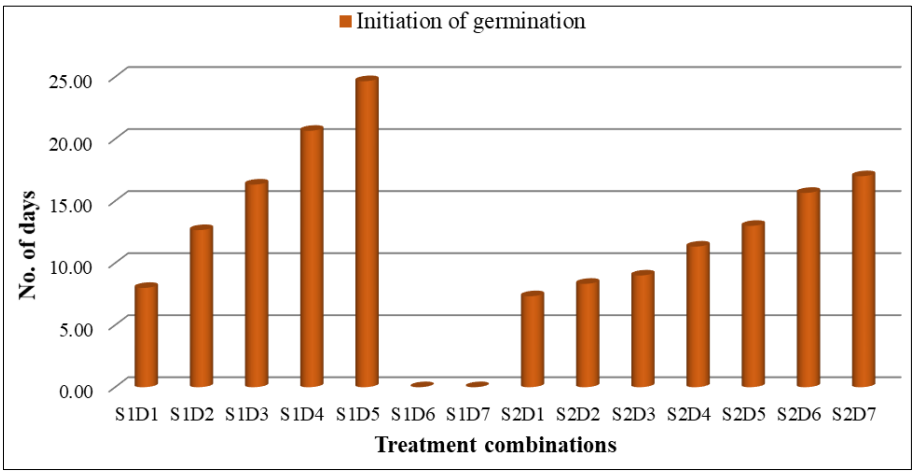


**Fig 1:** Effect of seed age and storage conditions on initiation of seed germination (days) in karonda (*Carissa carandas* L.)

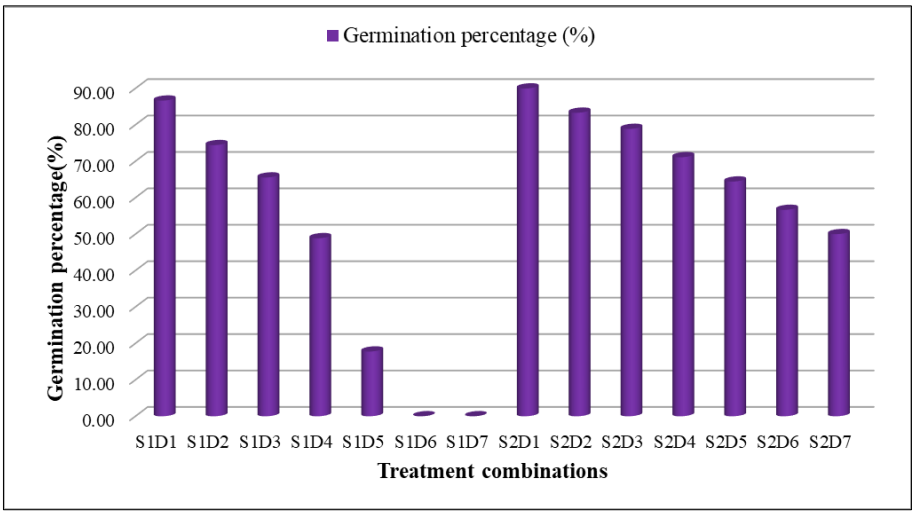


**Fig 2:** Effect of seed age and storage conditions on germination percentage (%) in karonda (*Carissa carandas* L.)

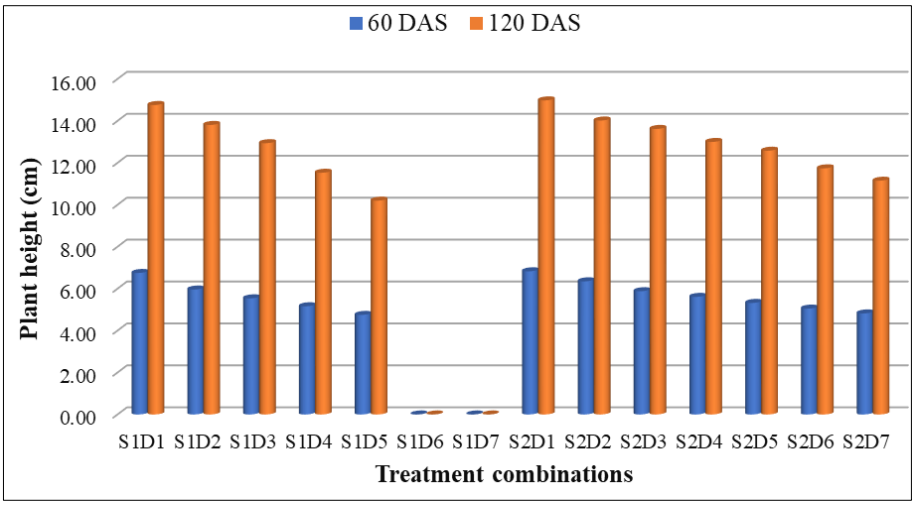


**Fig 3:** Effect of seed age and storage conditions on plant height (cm) at 60 and 120 DAS in karonda (*Carissa carandas* L.)

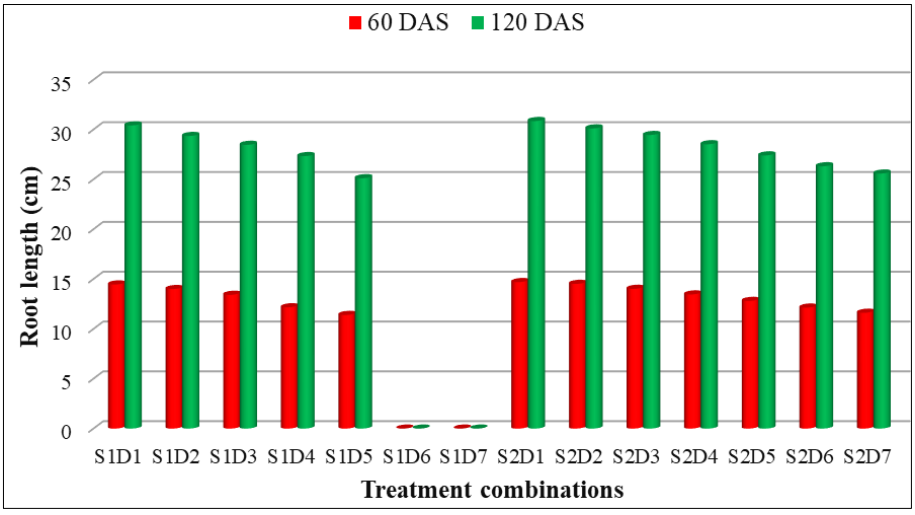


**Fig 4:** Effect of seed age and storage conditions on root length (cm) at 60 and 120 DAS in karonda (*Carissa carandas* L.)

## Conclusion

It can be concluded that, refrigerator storage and seeds sown immediately after extraction and the corresponding combination gave best results for all germination and growth parameters in karonda.

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