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Research Article

EFFECT OF VARIOUS PRE-SOWING CHEMICALS ON SEED GERMINATION AND VIGOUR IN KARONDA (*Carissa carandas* Linn.)

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Abstract: Karonda seeds are very hard and have low germination per cent but it is propagated through seeds. There are various constraints of low seed germination. Considering this a trial under the title Effect of various pre sowing chemicals on seed germination and vigour in Karonda (*Carissa carandas* Linn.) was carried out at the nursery of Horticulture Department, Khalsa College, Amritsar, Punjab during 2019-2020. The experiment was laid out in a Randomized Block Design with three replications, consisting of eleven treatments replicated thrice. The results of present investigation revealed that the Karonda seeds treated with KNO_3 1% Soaking (2hr) (T_3) recorded minimum number of days required for germination and maximum germination percentage was observed when Karonda seeds soaked in water for 12 hour (T_{10}).The treatment Thiourea2% soaking (2hr) (T_9) maintained its superiority in producing maximum, shoot diameter, shoot fresh weight and dry weight whereas length of seedling, dry weight of root, Vigour index-I and vigour index-II reported maximum in T_4 KNO_3 2% soaking (1hr). However, maximum survival percentage was observed inThiourea2% soaking (2hr) (T_9).

Keywords: *Germination, Karonda, KNO_3, Seedling, Superiority, Thiourea, Vigour*

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Introduction

Improvement in Karonda (*Carissa carandas* Linn.) belonging to family Apocynaceae with chromosome number 2n=22 is popularly known as "Bengal currant" or "Christ's Thorn" with other names as karamanda, karavanda, kaunda, kalivi and natal plum in India [1]. It is believed to be originated near the Himalayas, though some botanists place the fruit's origin to Java. The plant is found to be distributed in the Himalayas at elevations of 300-1800 m [2]. It is a native of India and grows wild in Maharashtra, Rajasthan, Uttar Pradesh, West Bengal, Bihar and in commercial plantations in the Varanasi district of Uttar Pradesh. The crop is grown for making beautiful juvenile hedge and used as a bio-fence because of presence of axillary spines [3]. There are more than 25 species in genus Carissa, out of these 5 species are indigenous to India. It has an excellent potential to be used for horticultural plantations in marginal and wastelands, owing to its hardy and xerophytic nature with wide adaptability to saline sodic soils with pH up to 10 [4]. It is a perennial, hardy and drought tolerant plant grown in wide range of soils. Its stem is rich in white latex, having sharp spines on branches [5]. A great beauty of plant is that its leaves are shinning and ornamental bearing flowers and fruits almost throughout the year [6]. Karonda can be propagated through seeds, cuttings, grafting, air layering and stooling but asexual propagation through cutting is difficult because rooting does not occur easily [7].

Seeds are *recalcitrant* and are relatively high in moisture content and possess a characteristic feature of losing their viability during desiccation. Seed germination is a complex adaptive trait of higher plants that are influenced by a large number of genes and environmental factors. Germination percentage of seed can be increased by soaking them in an aqueous solution of potassium nitrate (KNO_3). The time to germination after the soaking treatment is reduced. Seeds soaked in KNO_3 solution also produce seedlings that are initially more vigorous than seedlings from untreated seeds [8]. Thiourea has been successful in forcing the germination of freshly harvested seeds at temperatures that ordinarily inhibit germination.

Materials and Methods

The present investigation was carried out during 2019-2020 at the nursery of Department of Horticulture, Khalsa College, Amritsar. The whole experiment comprised of 11 treatments(T1-Control, T2-KNO_3 1% Soaking (1hr), T3-KNO_3 1% Soaking (2hr), T4-KNO_3 2% Soaking (1hr), T5-KNO_3 2% Soaking (2hr), T6-Thiourea1% Soaking (1hr), T7-Thiourea1% Soaking (2hr), T8-Thiourea2% Soaking (1hr), T9-Thiourea2% Soaking (2hr), T10-Water Soaking (12hr) and T11-Hot water Soaking (10min at 50°C) which were replicated thrice in a Randomized Block Design. Uniform and healthy seeds of Karonda *var.* Pink fruited were selected from plants in orchard of Khalsa College and used for the experiment. Freshly extracted hundred (100) seeds per treatment were sown in polybags containing potting mixture immediately after extraction in T1and in other treatments seeds were soaked in 1 % and 2 % KNO_3 and Thiourea solutions for 1 hour and 2 hours which were prepared by dissolving 10 and 20 g KNO_3 and Thiourea respectively in 1 litre of water. Normal distilled water soaking was done for 12 hours in T10 treatment in such a way that each and every seed was soaked homogenously in water whereas in treatment T11 seed soaking in hot water at 50°C for 10 minutes was done. 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. The observations pertaining to germination and vigour characters *viz.* days for initiation of germination, germination per centage, length of seedling, dry weight of shoot, dry weight of root, vigour index-I and vigour Index-II were recorded at 150 days of experiment.

Results and Discussion

Days taken for initiation of germination

The result of the present investigation revealed that the seeds treated with KNO_3 1% soaking (2hr) (T3) recorded minimum number of days taken for initiation of germination (6.05 days).

Table-1 *Effect of pre sowing chemicals on seed germination traits in Karonda*

Treatments	Days taken for initiation of germination	Germination(%)	Survival (%)
T_1	9.00	57.39	58.24
T_2	6.33	60.84	63.21
T_3	6.05	62.71	65.35
T_4	8.00	65.13	68.44
T_5	7.00	67.54	69.38
T_6	9.45	70.11	73.42
T_7	9.78	71.44	75.64
T_8	10.31	73.15	78.53
T_9	10.82	74.82	83.84
T_{10}	6.45	76.33	68.10
T_{11}	9.00	62.81	65.68
Mean	8.38	67.47	69.98
CD (p=0.05)	1.17	1.23	0.18

Table-2 *Effect of pre sowing chemicals on seedling growth and vigour in Karonda*

Treatments	Seedling length(cm)	Shoot diameter	Dry weight of root (g)	Shoot fresh weight (g)	Shoot dry weight (g)	Vigour index -1	Vigour index -2
T_1	25.20	2.19	0.16	0.17	0.04	1447.42	11.94
T_2	30.26	2.31	0.42	0.21	0.08	1839.97	30.38
T_3	30.50	2.32	0.43	0.22	0.09	1913.82	32.62
T_4	35.95	2.45	0.56	0.28	0.11	2342.81	43.66
T_5	31.55	2.46	0.44	0.37	0.14	2131.68	39.20
T_6	28.00	2.48	0.22	0.38	0.15	1963.87	25.96
T_7	30.00	2.51	0.27	0.51	0.21	2144.30	34.33
T_8	30.30	2.55	0.26	0.54	0.23	2117.56	35.87
T_9	30.46	2.67	0.21	0.63	0.28	2279.04	36.68
T_{10}	26.66	2.25	0.20	0.20	0.07	2036.16	20.63
T_{11}	26.33	2.23	0.19	0.19	0.05	1654.73	14.88
Mean	29.56	2.40	0.30	0.33	0.11	1988.30	29.65
CD (p=0.05)	0.23	0.05	0.015	0.01	0.01	65.68	1.79

The maximum number of days required for initiation of germination (10.82 days) were observed in the seeds treated with Thiourea 2% soaking (2hr) (T9). This was due to the fact that the involvement of KNO_3 in the activation of cytological enzymes along with increase in cell wall plasticity and better water absorption. It might have directly on embryo relieving it from dormancy through acted promoting protein synthesis and elongation of coleoptiles and leaves also helps in the production of ethylene. It created a balance between hormonal ratios in seed and reducing the growth preventable materials like ABA. Thus, the enhanced enzymatic reactions along with the suppression of inhibitors by these growth substances might have acted in faster germination. The relative advantage of treating Karonda seeds with various chemicals to reduce the period for germination and to remove the obstruction of embryo growth has been reported by Bhavya, *et al*., (2017) [1] in Karonda, Lay, *et al*., (2015) [9] and Samir, *et al*., (2015) [10] in papaya.

Germination percentage (%)

Seeds soaked in water for 12 hours (T10) recorded the maximum germination percentage (76.33%) and the lowest germination percentage (57.39%) was recorded in T1 (control).This might be attributed to the fact that seeds soaked in water at room temperature helped in softening the seed coat, removal of inhibitors and increased germination percentage in Karonda. Bhavya, *et al*., (2017) [1] in Karonda and Patil, *et al*., (2018) [11] also reported the same in jamun seedlings. Thiourea treatment significantly influenced the seed germination percentage due to dormancy break down and germination stimulating effects appearing to have more diverse biological activities because of its sulfhydral group. The present study is also in accordance with the research findings of Dhankhar and Singh (1996) [12], Cetinbas and Koyuncu (2006) [13] and Mane, *et al*., (2018) [14] in custard apple. Patel, *et al*., (2016) [15] and Gurung, *et al*., (2014) [16] in passion fruit also reported the same.

Length of seedling (cm)

It is evident from the data that maximum length of seedling (35.95 cm) was registered in treatmentT4- KNO_3 2% Soaking (1hr). Minimum length of seedling (25.20 cm) was recorded under control. Influence of potassium nitrate on length of seedling can be contributed to the fact that they have direct effect on stem elongation by inducing cell wall loosening, increasing cell wall extensibility, stimulating the wall synthesis, reducing the rigidity of cell wall and by increasing cell division leading to more growth. The present study is also in accordance with the research findings of Muralidhara, *et al*., (2015) [17], Reddy and Khan (2001) [18] and Venkata and Reddy (2005) [19] in mango. The research findings of Bhavya, *et al*., (2017) [1] in Karonda also corroborates the present findings.

Shoot diameter (mm)

Among the treatment's maximum (2.67 mm) shoot diameter was reported in seeds treated with Thiourea2% soaking (2hr) (T9) and was lower (2.19 mm) under control after 150 days of sowing (DAS).

Diameter at collar region is an important factor for giving support at initial stage which is a vital character in health of the seedling. Increase in stem diameter might be possible due to stimulation of cambium and its immediate cell progeny as observed by Parab, *et al*., (2017) [20], Patel, *et al*., (2016) [15] in papaya and Dhankhar and Singh (1996) [12]. The present study is also in accordance with the research findings of Anjanawe, *et al*., (2013) [21] in papaya seedlings.

Dry weight of root (g)

The results pertaining to the dry weight of roots revealed that the highest dry weight of roots (0.56 g) in T4 KNO_3 2% Soaking (2hr). The lowest value (0.16 g) was recorded under control.

The increased dry weight of seedling might due to the enhanced root length. The mobilization of stored nutrients within the plant might have resulted in the root growth parameters with increase in dry weight of root. The present results are also in line with the findings of Bhavya, *et al*., (2017) [1] in Karonda and Barathkumar (2019) [22] in amla.

Fresh weight of shoot (g)

Fresh weight of shoot at 150 days after sowing (DAS) was maximum (0.63g) in seeds treated with T9 -Thiourea 2% Soaking (2hr) followed by T8 and T7 (0.54g and 0.51g) respectively while (T1) Control recorded minimum fresh weight of shoot (0.17g). The positive effect of chemical stimulators such as Thiourea on fresh weight of shoots might be due to an improvement in seedling emergence rate due to enhanced supply of soluble carbohydrates to the growing embryo, which was caused by an increase in a-amylase activity. Rapid and uniform emergence as reported by Bhavya *et al*., (2017) [1] in Karonda.

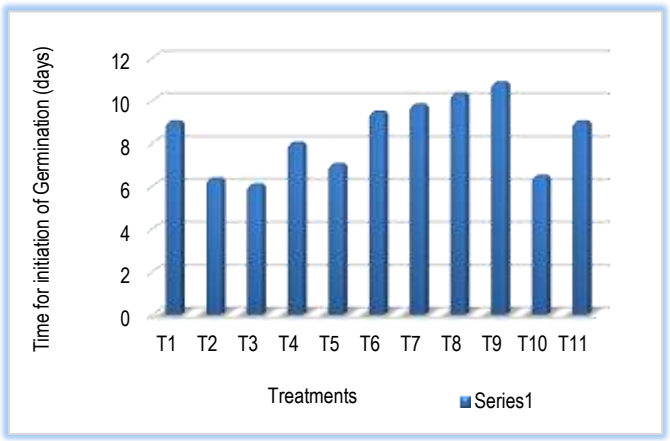

Fig-1 Effect of pre-sowing chemicals on time for initiation of germination in Karonda

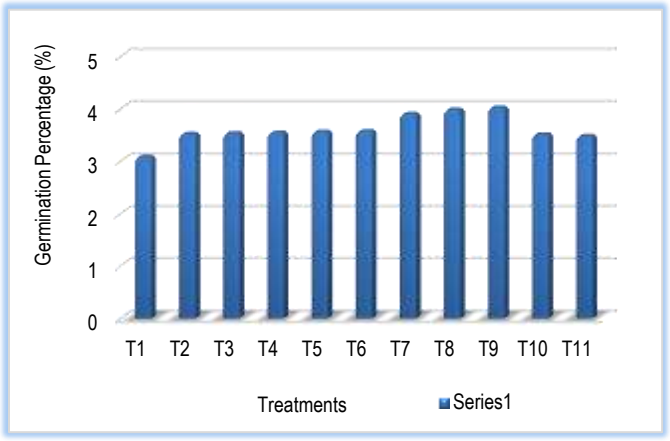

Fig-2 Effect of pre-sowing chemicals on germination percentage in Karonda

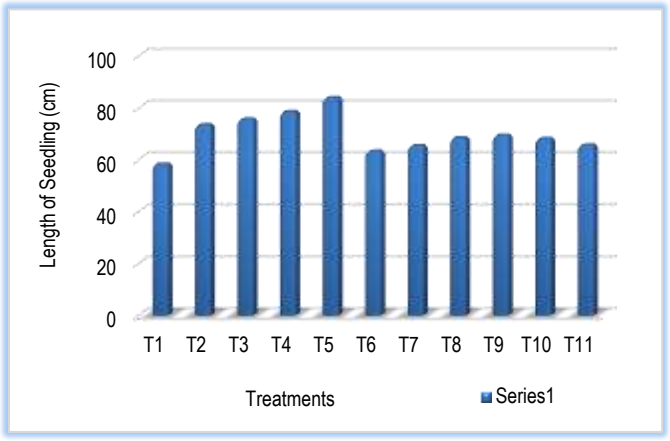

Fig-3 Effect of pre-sowing chemicals on length of seedling in Karonda

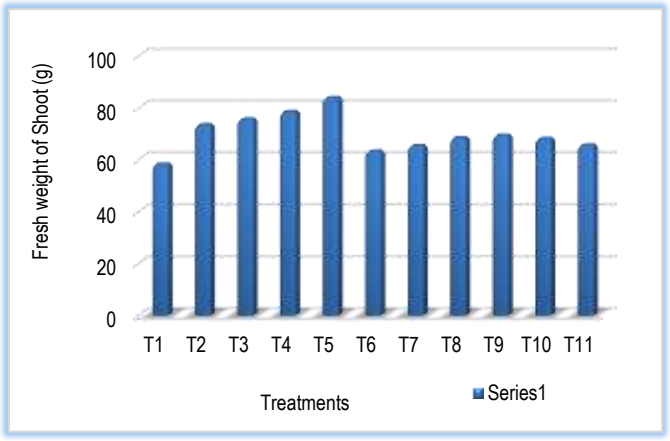

Fig-4 Effect of pre-sowing chemicals on fresh weight (g) of shoot in Karonda

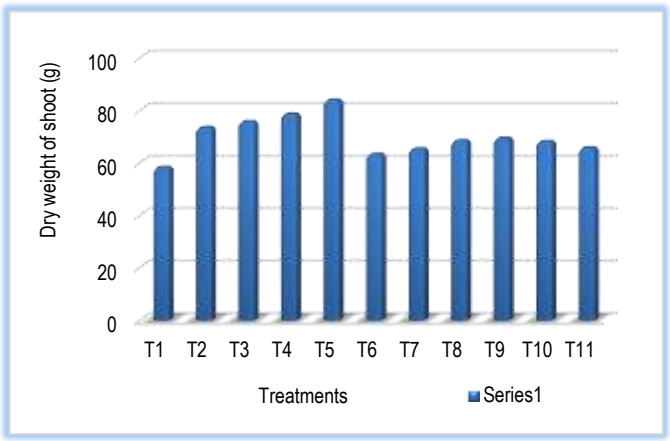

Fig-5 Effect of pre-sowing chemicals on dry weight (g) of shoot in Karonda

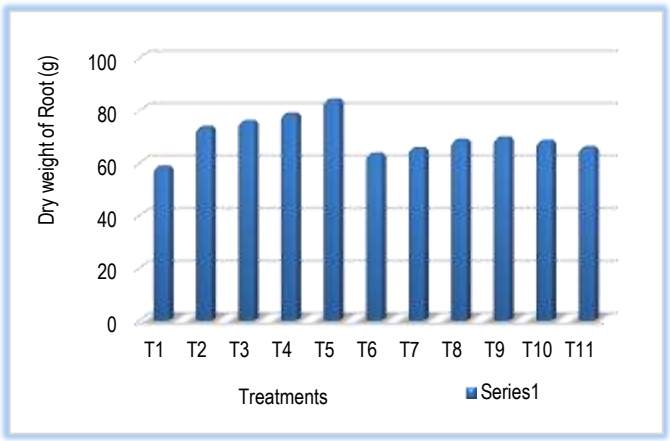

Fig-6 Effect of pre-sowing chemicals on dry weight (g) of root in Karonda

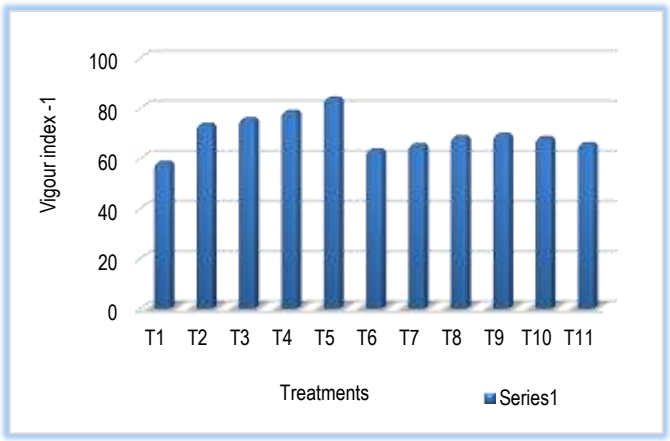

Fig-7 Effect of pre-sowing chemicals on vigour index-I in Karonda

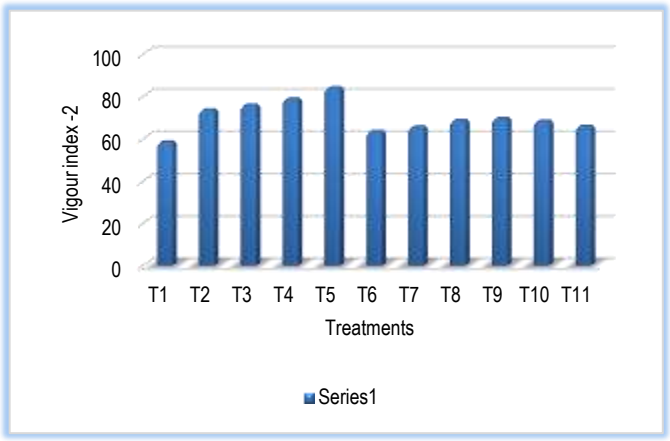

Fig-8 Effect of pre-sowing chemicals on vigour index-II in Karonda

Dry weight of shoot (g)

From the results it is clear that the dry weight of the shoot at 150 days after sowing was found the highest (0.28g) in seeds treated with T9 -Thiourea 2% Soaking (2hr) followed by T8 and T7 with (0.23g and 0.21g) dry weight respectively while the lowest(0.04 g) was recorded in (T1) control. The increased dry weight of seedling may be due to the enhanced root and shoot length. The utilization of stored nutrients available in the plant might have led to an increase in the dry weight of shoot. The findings of Bhavya, *et al*., (2017) [1] in Karonda and Barathkumar (2019) [22] in amla are in support with the present results.

Seedling vigour index-I (cm)

The seedling vigour index-I influenced by period of seed storage clearly signifies that the seeds treated with (T4) KNO_3 2% Soaking (1hr) recorded maximum seedling vigour index-1(2342.81) followed by T9 (2279.04) and minimum (1521.03) was observed in T1 (Control). The maximum vigour index-1 with KNO_3 might be due to the vigorous growth of rootstock, greater seedling emergence ability, cotyledonary photosynthesis and maximum germination percentage. This also might be due to enhanced uptake of nitrogen, potassium, water and nutrients and resulted in better root and shoot growth which might have resulted in maximum vigour index as observed by Kumar, *et al*., (2007) [23], Pampanna and Sulkieri (2001) [24], Rajamanickam and Balakrishnan (2004) [25] and Aatla and Srihari (2013) [26] in mango.

Seedling vigour index-II (g)

Throughout the whole study the data on the seedling vigour index- II revealed that the seeds treated with (T4) KNO_3 2% soaking (1hr) showed the highest vigour index-II (43.66) followed by T5 (39.20) than other treatments and minimum (11.94) was observed in (T1) Control. The maximum seedling vigour index-II with KNO_3 might be due to the increase in number of leaves and root length lead to the overall assimilation and redistribution of photosynthates within the plant and resulted in higher dry weight of seedling and thereby increased the vigour of seedling reported by Reddy and Khan (2001) [18], Kumar, *et al*., (2007) [23], Rajamanickam and Balakrishnan (2004) [25] and Aatla and Srihari (2013) [26] in mango. The present results are in line with the research findings of Bhavya, *et al*., (2017) [1] in Karonda.

Survival percentage (%)

Significantly maximum survival percentage (83.84 %) was found with T9Thiourea2% Soaking (2hr) whereas, the minimum survival percentage (58.24 %) was observed in control. This might be due to the overall performance in relation to growth parameters were good in same treatment which ultimately increased the survival percentage. The present results are in consonance with the research findings of Bhavya, *et al*., (2017) [1] in Karonda and Tripathi, *et al*., (2014) [14] in custard apple. Dhankhar and Singh (1996) [12] reported the same in aonla.

Conclusion

Based on the results of the experiment it can be concluded that among seed treatment chemicals, Thiourea2% soaking (2hr) was found effective with respect to growth parameters, production of vigour seedlings and higher survival percentage of Karonda as compared to other seed treatment chemicals. Therefore, morphological characters of seedlings can be enhanced by soaking seeds with Thiourea 2% soaking (2hr).

Application of research: Increasing the seed germination of Karonda which will help in the production of a large quantity of planting material to boost cultivation.

Research Category: Seed Germination

Abbreviations: DAS- Days after sowing, T- Treatment, KNO_3- Potassium nitrate

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Department of Horticulture (Agriculture), Khalsa College, Amritsar, 143001, India

Cultivar / Variety / Breed name: (*Carissa carandas* Linn.) - Pink fruited

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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