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# Germination and Seedling Vigour Studies in Cashew (*Anacardium occidentale* L) Varieties

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**ABSTRACT: An experiment was carried out to study the germination and seedling vigour in different cashew varieties at the Agricultural and Horticultural Research Station, Bavikere with ten cashew varieties (Ullal-1, Ullal-2, Ullal-4, VRI-1, VRI-3, Vengurla-3, Vengurla-4, Vengurla-7, Bhaskar and Priyanka) and three replications in Randomized Complete Block Design during the year 2021-22. The results of the study revealed that, the variety Priyanka showed the highest germination per cent (94.24 %) and seedling vigour index-1 (2941.65). The variety vengurla-4 showed the highest shoot length (52.76 cm), number of leaves (17.26), number of internodes (7.25) and plant girth (1.82 cm). Thus, it implies that the variety Priyanka has the highest germination percentage, while the variety Vengurla-4 possesses significantly superior traits in terms of growth parameters, which exhibits that both the varieties can be used as a potential rootstock to produce high-quality seedlings of cashew.**

**Keywords:** Cashew, Germination, Seedling vigour index, Rootstock, Priyanka and Vengurla-4.

## INTRODUCTION

Cashew (*Anacardium occidentale* L.), a member of the Anacardiaceae family, is one of the nation's most significant commercial plantation crops and a major source of foreign exchange. It is thought to be a native of Northeastern Brazil's lower Amazon region. Around 4.18 million tonnes of cashews are produced globally each year. Cashew is grown in an area of 2.0 million hectare worldwide (Anon., 2021).

Portuguese missionaries brought cashew to India for the first time in the 16$^{th}$ century in Goa and the Malabar Coast, which eventually served as the primary hubs for distribution to other areas of the country (De Costa, 1978). India has long been a significant producer of cashews. The top producers of raw cashews are Vietnam (8, 17,000 tonnes), India (6, 18,000 tonnes), and Brazil (2, 51,268 tonnes). India is the largest and most prolific producer of cashew kernels. It is currently the world's second-largest producer of raw cashews, although it tops the list of countries that produce the most cashew kernels and has the most land covered (0.72 million hectares (DCCD, 2017).

Cashew seed is considered to be a new world food. Among the most popular tree nuts consumed worldwide, it comes in third place. In many different cuisines and civilizations around the world, cashew is a common dried fruit or ingredient. Additionally, the crushed form, known as cashew butter, is employed. Cashew kernels are free from bad cholesterol and are quite abundant in unsaturated fatty acids. The shells contain high-quality oil known as cashew nut shell liquid (CSNL) which has got broad industrial uses. CNSL is a versatile raw material used in surface coating paints, varnishes, as well as in the production of polymers (Telascreaa *et al*., 2014). The residue of the shell after the extraction of CNSL is used as fuel in the cashew processing units and CNSL extraction plants. The cashew apple is eaten fresh or mixed in fruit salads and it is also used in the preparation of juice. Cashew apple can be distilled to produce alcoholic beverages Feni and wine (Mohanty *et al*., 2006).

Cashew is an important export earning plantation crop of India. Presently, total cashew nut production in the country is 7.74 lakh metric tonnes from an area of 11.66 lakh hectares with a productivity of 749 kg per ha.

Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa, and West Bengal are the principal cashew-growing states in India, Maharashtra tops the list above. According to the cashew trade pattern, 8 to 9 million cartons of cashews are traded globally each year. The top three exporting nations of cashews worldwide are India (4.5 million cartons), Vietnam (2.3 million cartons) and Brazil (1.75 million cartons). While in Karnataka, cashew is grown in an area of 1.29 lakh hectares, producing 89, 447 MT nuts with a productivity of 672 kg/ha, is one of the country's leading cashew growing states. The principal cashew-growing regions in Karnataka include Belgaum, Shimoga, Kolar, and Udupi as well as Dakshina and Uttara Kannada. The government has made great efforts to increase cashew planting in Karnataka's interior non-traditional areas as well as in traditional ones (Anon., 2021).

The decreasing productivity is believed to be the result of a variety of problems linked to modern agriculture. The majority of the cashew is produced by self-sown, wildly expanding cashew trees. According to the World Bank, only 2 to 3 per cent of production comes from cashew plants that are managed methodically. It is grown on marginal and waste sites that couldn't be used effectively for other plantations or field crops resulting in low production, also cashew is still considered and grown as a wild tree. The most obvious cause of low yields, aside from bad management is the use of poor genetic planting material with naturally low productivity. Hence, there is need for the production of rootstocks with good germination and high vigour for the production of genuine quality grafts.

Akos *et al*. (2017) studied the effect of interaction between seed size and sowing depth of cashew (*Anacardium occidentale)* on seedlings emergence. The results showed that small size seeds sown at 5cm depth and large sized sown at 10 cm depth showed early germination and seedling emergence. Mog *et al*. (2017) carried out a study on variation in seed mass as a key factor in germination and seedling vigour in cashew (*Anacardium occidentale* L.). They concluded that variation in seed size has significant influence on germination and seedling vigour with large size seeds exhibiting better germination percentage, vigour, growth and survival, higher root to shoot ratio and ability to produce high quality seedlings of cashew. Prashikhan *et al*. (2019) studied the response of different growth regulators and seed treatments of cashew varieties (BPP-5, BPP-8, VRI-2, and H-1). The results revealed that variety BPP-8 recorded significantly higher germination percentage (92.56), seedling height (29.01 cm), seedling girth (4.23 cm), number of leaves (23.78) and internodal length (7.37) followed by H-1 (92.30) than the other two varieties.

## MATERIAL AND METHODS

The experiment was carried out at Agricultural and Horticultural Research Station (AHRS), Bavikere, during 2021-22 to study the germination and seedling vigour studies in cashew (A*nacardium occidentale* L) varieties. The experiment was laid out in completely randomized design with with ten cashew varieties (Ullal-1, Ullal-2, Ullal-4, VRI-1, VRI-3, Vengurla-3, Vengurla-4, Vengurla-7, Bhaskar and Priyanka) and three replications. The seeds were collected from cashew orchard of AHRS, Bavikere. The seeds after harvest were sun dried for two days. Uniform sized, good shaped and heavy seeds were selected and dipped in water. Floated seeds were discarded and only sunken seeds were taken as seed material and then dried for a day before sowing. The potting mixture was prepared by mixing soil, sand and FYM in the ratio 2:1:1. Polythene bags of 25 cm × 15 cm size and 200 gauge thickness were used for filling the potting mixtures. Seeds were sown at a depth of 3.0 cm in vertical position. Light irrigation was provided just after sowing. Watering was done regularly and regular hand weeding was done, whenever the weeds appeared. During the course of experiment, prophylactic plant protection measures were taken to control pests and diseases of the seedlings.

Five seedlings were selected randomly and labelled from each treatment in every replication for recording observations.

**Germination percentage.** Germination counts were recorded at two days interval commencing from the date of sowing till 30 days after sowing and expressed in percentage.

**Shoot length (cm).** The shoot length was measured from the ground level to the growing tip with the help of 60 cm scale. The observations were taken from five randomly selected and tagged seedlings from each treatment at 30, 60 and 90 days after sowing, the mean was calculated and represented in centimeter.

**Shoot girth (mm).** The shoot girth of the five randomly tagged seedling was measured at 5 cm above the soil by using vernier callipers. The observation was taken at 30, 60 and 90 days after sowing. The mean shoot girth calculated and expressed in millimeter.

**Number of leaves per seedling.** The number of leaves present on each seedling was counted. The observations were taken at 30 days interval. The average number of leaves per seedling was worked out.

**Number of internodes.** The number of internodes present on each observational seedling was counted. The observations were taken at 30 days interval. The average number of internode per seedling was worked out.

**Seedling vigour index-I.** Seedling vigour index-I is the product of germination per cent and seedling length, which can be calculated as per the following formula given by Abdul Baki (Kandaswamy *et al*., 2020)

Seedling vigour index-I = Germination% × Seedling length (cm)

**Seedling fresh weight (mg).** The seedlings were uprooted and weighed on digital weighing balance at 90 days after sowing and fresh weight was recorded and expressed in grams.

**Seedling dry weight (mg).** The uprooted 90 days old seedling was dried in 65$^{o}$C for 60 minutes in hot air oven. Then the dry weight was recorded using digital weighing balance and expressed in grams.

**Seedling vigour index-II.** Seedling vigour index-II is the product of germination per cent and dry weight of seedling, which can be calculated as per the following

formula given by Abdul Baki (Kandaswamy *et al*., 2020)

Seedling vigour index-II = Germination % x Seedling dry weight (g)

## RESULTS AND DISCUSSION

The results revealed that there was a significant difference among all the parameters which is observed 90 days after sowing. The highest germination percentage was noted in the variety Priyanka (95.24 %), which was on par with the variety Vengurla-4 (91.06 %) and Ullal-1 (89.56 %). While, the lowest germination percentage was noted in the variety VRI-3 (60.32 %). This might be due to the varietal characteristics and genetic makeup of the varieties and presence of hard seed coat in the variety VRI-3. The results were in conformity with the observation made by Bakshi (1963); Singh and Srivastava (1982); Sinnadurai (1975); Shaban (2010). The maximum seedling vigour index-I was recorded in the variety Priyanka (2941.65). Which is to the increase in germination percentage and seedling height which have contributed to higher vigour index I. Similar reports of maximum seedling vigour index were also reported by Anburani and Shakila (2010); Kandaswami *et al.* (2020). The highest shoot length was recorded in the variety Vengurla-4 (52.76 cm.). Vengurla-4 exhibited vigorous height growth, which might be due to the varietal characteristics and genetic makeup of the variety *i.e.,* vigorous growth in nature. The highest shoot girth was recorded in the variety Vengurla-4 (1.82 mm.). This might be due to high seed weight and thin endocarp which supplies all the necessary nutrients and growth regulators required for rapid cell elongation. These results are with the findings of Mog *et al*. (2017); Muralidhara *et al*. (2016). The maximum number of leaves was recorded in the variety Vengurla-4 (17.26). While, the least number of leaves was recorded in the variety VRI-1 (13.29). The production of more number of leaves in Vengurla-4 is might be due to vigorous growth, more number of branches which in turn facilitates better harvest of sunshine by the plants to produce more number of leaves. The number of leaves was minimum in VRI-1 because of reduced growth and seedling height, the same was observed by Quayom (2011) (Table 1). The maximum fresh weight of seedlings was recorded in the variety Priyanka (62.45 g.). While, the least fresh weight was recorded in the variety VRI-3 (45.35). Wherein, the maximum dry weight was recorded in the variety Priyanka (22.30 g.). While, the least dry weight was recorded in the variety VRI-3 (16.20 g.). The increased fresh and dry weight of seedlings may be due to the enhanced root length, shoot length and number of leaves that might have led to the overall assimilation and redistribution of photosynthates within the plant. The results are in agreement with the findings of Dhankhar and Singh (1996); Chacko *et al*. (1996). The maximum seedling vigour index-II was recorded in the variety Priyanka (2101.55). While, the least seedling vigour index-I was recorded in the variety VRI-3 (977.18). Which might be due to increase in germination percentage and dry weight of the seedlings which have contributed to higher vigour index II. Similar reports of maximum seedling vigour index were also reported by Biradar *et al*. (2005); Anburani and Shakila (2010) (Table 2).

**Table 1: Study on germination parameters in Cashew (*Anacardium occidentale* L.) varieties at 90 days after sowing.**

| Varieties | Germination % | Seedling Vigour Index (SVI) | Shoot length (cm) | Shoot Girth (mm) | Number of leaves |
|---|---|---|---|---|---|
| Ullal-1 | 91.06 | 2624.88 | 48.62 | 1.78 | 15.78 |
| Ullal-2 | 78.85 | 2061.12 | 46.50 | 1.77 | 14.85 |
| Ullal-4 | 83.34 | 2349.10 | 45.56 | 1.73 | 15.10 |
| VRI-1 | 73.10 | 1683.79 | 43.75 | 1.73 | 13.29 |
| VRI-3 | 60.32 | 1562.01 | 42.27 | 1.75 | 15.45 |
| Vengurla-3 | 79.21 | 2062.79 | 46.96 | 1.74 | 16.78 |
| Vengurla-4 | 89.56 | 2273.52 | 52.76 | 1.82 | 17.26 |
| Vengurla-7 | 82.55 | 2247.49 | 48.67 | 1.75 | 15.67 |
| Bhaskara | 65.02 | 1850.72 | 45.87 | 1.79 | 14.27 |
| Priyanka | 94.24 | 2941.65 | 52.57 | 1.80 | 14.23 |
| **Mean** | 79.72 | 2165.71 | 47.35 | 1.76 | 15.27 |
| **S.Em±** | 0.60 | 36.89 | 0.79 | 0.02 | 0.11 |
| **CD@5%** | 1.78 | 110.45 | 2.36 | 0.07 | 0.33 |

**Table 2: Fresh weight, dry weight and seedling vigour index-II in cashew (*Anacardium occidentale* L.) varieties.**

| Variety | Fresh weight of seedling (g) | Dry weight of seedling (g) | Seedling vigour index-II |
|---|---|---|---|
| Ullal-1 | 60.10 | 21.46 | 1954.15 |
| Ullal-2 | 56.23 | 20.08 | 1583.31 |
| Ullal-4 | 54.37 | 19.42 | 1618.46 |
| VRI-1 | 48.65 | 17.38 | 1270.48 |
| VRI-3 | 45.35 | 16.20 | 977.18 |
| Vengurla -3 | 54.01 | 19.29 | 1527.96 |
| Vengurla-4 | 56.84 | 20.30 | 1818.07 |
| Vengurla-7 | 58.95 | 21.05 | 1737.68 |
| Bhaskar | 53.81 | 19.22 | 1249.68 |
| Priyanka | 62.45 | 22.30 | 2101.55 |
| **Mean** | 55.08 | 19.67 | 1583.85 |
| **S.Em ±** | 0.64 | 0.30 | 22.00 |
| **CD @ 5 %** | 1.90 | 0.89 | 65.37 |

## CONCLUSION

Based on the above results it can be concluded that variety Priyanka has the highest germination percentage, which has a significant influence on seedling vigour, while the variety Vengurla-4 possesses significantly superior traits in terms of both the germination and growth parameters, which exhibits that both the varieties can be used as a potential rootstock to produce high-quality seedlings of cashew.

## FUTURE SCOPE

Investigations on physiological and biochemical aspects of seed germination may be carried out.

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**Conflict of Interest.** None.

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