



International Journal of Agriculture and Food Science

ISSN Print: 2664-844X
 ISSN Online: 2664-8458
 NAAS Rating (2026): 4.97
 IJAFA 2026; 8(10): 283-290
www.agriculturaljournals.com
 Received: 14-08-2026
 Accepted: 25-09-2026
 Published: 09-10-2026

Kadam Pranayi Viresh
 M.Sc. Scholar, Department of
 Fruit Science, College of
 Horticulture, Dr. Balasaheb
 Sawant Konkan Krishi
 Vidyapeeth, Dapoli, Ratnagiri,
 Maharashtra, India

Ghavale SL
 Assistant Professor, College of
 Horticulture, Dr. Balasaheb
 Sawant Konkan Krishi
 Vidyapeeth, Dapoli, Ratnagiri,
 Maharashtra, India

Malshe KV
 Agronomist, Regional Coconut
 Research Station, Bhatye,
 Ratnagiri. College of
 Horticulture, Dr. Balasaheb
 Sawant Konkan Krishi
 Vidyapeeth, Dapoli, Ratnagiri,
 Maharashtra, India

Thorat SB
 Associate Professor
 (CAS), College of Horticulture,
 Dr. Balasaheb Sawant Konkan
 Krishi Vidyapeeth, Dapoli,
 Ratnagiri, Maharashtra, India

MG Palshetkar
 Associate Professor (CAS),
 Department of Agril., Botany,
 College of Agriculture, Dr.
 Balasaheb Sawant Konkan
 Krishi Vidyapeeth, Dapoli,
 Ratnagiri, Maharashtra, India

Corresponding Author:

Kadam Pranayi Viresh
 M.Sc. Scholar, Department
 of Fruit Science, College of
 Horticulture, Dr. Balasaheb
 Sawant Konkan Krishi
 Vidyapeeth, Dapoli,
 Ratnagiri, Maharashtra,
 India

Effect of different pre-sowing seed treatments on seed germination and subsequent seedling growth of marking nut (*Semecarpus anacardium* L.) under Konkan agroclimatic condition

Kadam Pranayi Viresh¹, Ghavale SL², Malshe KV³, Thorat SB⁴, MG Palshetkar⁵

DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i10d.2031>

ABSTRACT

A field study on the effect of different pre-sowing seed treatments on germination and subsequent seedling growth of marking nut (*Semecarpus anacardium* L.) under Konkan agroclimatic condition was conducted at College of Horticulture, Dapoli, in the year 2025 to study the effect of different pre-sowing seed treatments on germination, survival and subsequent seedling growth of marking nut. The experiment was laid out in a randomized block design comprising nine treatments with three replications. The treatments viz., T_1 : control, T_2 : soaking seeds in normal water (24 hours), T_3 : hot water soaking for 20 min. (80 °C), T_4 : scarification by conc. H_2SO_4 for 1 minute, T_5 : scarification by conc. H_2SO_4 for 3 minutes, T_6 : scarification by conc. H_2SO_4 for 5 minutes, T_7 : soaking seeds in GA_3 50 ppm for 24 hours, T_8 : soaking seeds in GA_3 100 ppm for 24 hours and T_9 : soaking seeds in GA_3 150 ppm for 24 hours. Among the treatments, T_9 recorded superior performance for most of the parameters. It recorded the significantly highest germination percentage (71.33%), survival percentage (90.42%), seedling height (50.01 cm), seedling girth (8.98 mm), number of leaves per seedling (15.47), leaf area (183.67 cm²), primary root length (42.27 cm), number of secondary roots (45.43), fresh shoots weight (42.00 g), dry shoots weight (10.60 g), fresh roots weight (139.97 g), dry roots weight (27.40 g), root volume (96.00 ml), seedling vigour index-I (6558.56) and seedling vigour index-II (2710.54). The treatment T_6 recorded the minimum number of days required for germination (11.33 days) but comparatively lower performance for other parameters. The maximum shoot:root ratio (0.57) was recorded with T_8 . Thus, among the different pre-sowing seed treatments evaluated, soaking seeds in GA_3 150 ppm for 24 hours (T_9) was found to be the most effective for enhancing seed germination, survival, seedling growth and vigour of marking nut.

Keywords: Marking nut, *Semecarpus anacardium*, seed treatment, Conc. H_2SO_4 , GA_3 , survival percentage

Introduction

Marking nut (*Semecarpus anacardium* L.), popularly known as bhilawa, oriental cashew, dhobi nut tree and varnish tree, is an underutilized deciduous tree belonging to family Anacardiaceae. Nut produces a water-insoluble permanent mark on clothes. It held significant cultural, medicinal and economic importance across South and Southeast Asia for centuries (Upreti *et al.*, 2016) [1]. It is distributed across diverse geographical locations, ranging from outer Himalayas to Coromandel Coast, extending through Africa, East Asia, Indian subcontinent, Indo-Malaysian region, western peninsula and North Africa. In India, it is widely distributed in tropical and subtropical regions, including Maharashtra, Bihar, West Bengal, Odisha, Karnataka, Tamil Nadu and Madhya Pradesh. Tree is a medium to large deciduous, reaching 15–25 m in height, with grey bark that exfoliates in small, irregular flakes. Phyllotaxy is alternate with simple, ovate-oblong laminae measuring 30–60 cm in length and 12–30 cm in width, exhibiting a rounded apex. Leaves are coriaceous, glabrous on the adaxial surface and sparsely pubescent abaxially. Inflorescences are greenish-white panicles, emerging synchronously with foliar flush during pre-monsoon months. Fruit is an obovoid drupe, approximately 2.5 cm in length, smooth and lustrous black at maturity. The species shows no strict edaphic preference and exhibits moderate shade tolerance. The fruit, kernel, seed oil and resinous exudate have several traditional and industrial applications, making the species an important multipurpose tree resource (Upreti *et al.*, 2016; Semalty *et al.*, 2010) [1, 2]. Kernel contains appreciable amounts of protein, fat, carbohydrates, minerals and essential amino acids, highlighting its nutritional potential (Semalty *et al.*, 2010; Vijay *et al.*, 2025) [2, 3]. However, the major constraints in cultivation and utilization are availability of quality planting material. Propagation is mainly carried out through seeds but seed germination is often poor, delayed and irregular.

The presence of a hard seed coat is considered an important factor contributing to seed dormancy and poor germination. A hard seed coat can restrict water absorption and gaseous exchange, thereby interfering with imbibition and respiration during the initial stages of germination (Yang *et al.*, 2007) [4]. Consequently, untreated seeds may require a longer period for germination and may produce uneven seedlings. Henceforth, the pre-sowing seed treatments are important for overcoming dormancy and improving germination and subsequent growth such as water soaking, hot water treatment, acid scarification and PGR can modify seed-coat permeability and stimulate physiological and biochemical processes associated with germination. The GA₃ plays an important role in promoting germination by stimulating metabolic activity and the synthesis of hydrolytic enzymes, thereby facilitating the utilization of stored food reserves during seed germination and early seedling growth. The scarification can help overcome physical restrictions imposed by hard seed coats. Developing an effective treatment to ensure rapid, uniform germination and vigorous seedling production is essential. Improving these nursery techniques will support conservation efforts and provide an alternative rootstock for cashew, ultimately minimizing stem and root borer attacks in cashew plantations. Therefore, the research was undertaken to evaluate the effect of different pre-sowing seed treatments on seed germination and subsequent seedling growth and to identify a suitable pre-sowing treatment for efficient quality planting materials production.

Materials and Methods

A field study was conducted at College of Horticulture, Dapoli, in 2025 to study the effect of different pre-sowing seed treatments on seed germination, survival and subsequent seedling growth of marking nut under Konkan agro-climatic conditions. Experiment was laid out in a randomized block design comprising nine treatments with three replications. The treatments viz., T₁: control, T₂: soaking seeds in normal water (24 hours), T₃: hot water soaking for 20 min. (80°C), T₄: scarification by conc. H₂SO₄ for 1 minute, T₅: scarification by conc. H₂SO₄ for 3 minutes, T₆: scarification by conc. H₂SO₄ for 5 minutes, T₇: soaking seeds in GA₃ 50 ppm for 24 hours, T₈: soaking seeds in GA₃ 100 ppm for 24 hours and T₉: soaking seeds in GA₃ 150 ppm for 24 hours. The observations on days to germination, germination percentage, germination pattern, survival percentage, seedling height, girth at collar region, number of leaves, leaf area, primary root length, number of secondary roots, fresh and dry shoots weight, fresh and dry roots weight, shoot: root ratio, absolute growth rate, relative growth rate, root volume and seedling vigour index were recorded at regular intervals up to 180 days after sowing. The seeds were selected from healthy, heavy bearing and ripened fruits from nearby villages during the month of March-April. For sowing polybags of 6" × 8" size were filled with soil and well decomposed FYM in 3:1 proportion. The depth of sowing was maintained at 2 cm while seeds were carefully covered with thin layer of potting media. The treated seeds were sown in polybags with sufficient holes for proper drainage. Watering was done as per requirement. Optimum moisture of germinating media was maintained during the period of seed germination and growth. In order to prevent the pest and diseases attack, the proper plant protection schedule was followed during the study. The collected experimental data on various parameters during the study were statistically analysed with the help of randomized block design method suggested by Panse *et al.* (1995) [5] and mean were taken for the comparison and interpretation of results.

Results and Discussion

Days required for germination

The significant variation was observed among the pre-sowing seed treatments for days required for germination (Table 1). Minimum days required for germination was recorded in T₆ (11.33 days), where seeds were scarified by conc. H₂SO₄ for 5 minutes, and it was statistically at par with T₅ (12.00 days), T₄ (12.33 days) and T₉ (13.67 days). Maximum time for germination was recorded in control (T₁),

with 25.33 days. The earlier germination in acid-scarified seeds could be attributed to weakening of hard seed coat, facilitating water imbibition and gaseous exchange and thereby promoting the initiation of germination. The similar results were also reported by Chatar *et al.* (2025) [6] and Bhosale (2014) [7] in marking nut.

Germination percentage

The pre-sowing seed treatments significantly influenced germination percentage (Table 1). Highest germination percentage (71.33%) was recorded in T₉, followed by T₈ (56.67%) and T₇ (51.33%), T₃ (40.00%), T₂ (36.67%) while the lowest (14.00%) was recorded in T₆, compared with 15.33% the control. The superior performance of GA₃ treated seeds may be attributed to its role in overcoming dormancy, stimulating hydrolytic enzyme activity and mobilizing stored food reserves required for embryo growth and radicle emergence. The increase in germination with increasing GA₃ concentration further indicated its beneficial effect on germination of marking nut seeds. Similar results were also reported by Bhosale (2014) [7] and Haque *et al.* (2022) [8] in marking nut.

Germination pattern

The germination pattern was markedly influenced by pre-sowing treatments (Fig. 1). During 0–15 days, germination was observed mainly in acid-scarification treatments and GA₃ 150 ppm, with highest initial germination (9.33%) in T₄. At 16–30 days, germination increased considerably, with T₉ recording the highest germination (55.33%), followed by T₈ (39.33%), whereas the control recorded only 4.67%. At 31–45 days, T₉ maintained the highest cumulative germination (70.00%), followed by T₈ (54.67%) and T₇ (50.67%). At 46–60 days, final germination ranged from 14.00 to 71.33%, with T₉ recording the highest germination (71.33%), followed by T₈ (56.67%) and T₇ (51.33%). Acid scarification promoted early germination by weakening hard seed coat; however, prolonged exposure to concentrated H₂SO₄ appeared to reduce final germination, possibly due to injury of the seed. Overall, treatment with GA₃ 150 for 24 hours ppm resulted in the earliest and highest cumulative germination, indicating its effectiveness in improving germination percentage.

Survival percentage

The survival percentage ranged from 72.14 to 90.42%, with a mean of 81.59% (Table 1). The significantly highest survival (90.42%) was in T₉, which was at par with T₈ (88.42%), T₃ (86.33%), T₇ (84.48%), T₂ (81.06%) and T₄ (80.91%). Lowest survival (72.14%) was in T₆. Higher survival under GA₃ 150 ppm may be associated with improved seedling vigour, enhanced mobilization of stored reserves and better root and shoot development, which favour establishment and reduce seedling mortality. Comparable results were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut, Barche *et al.* (2010) [10] in papaya and Banyal *et al.* (2022) [11] in guava.

Seedling height (cm)

Data on seedling height showed significant variation among the treatments at all growth stages (Table 2). At 30 DAS, seedling height ranged from 7.93 to 18.11 cm. Highest seedling height (18.11 cm) was in T₉, which was at par with T₈ (17.67 cm), whereas the lowest (7.93 cm) was in T₆. At 180 DAS, the maximum seedling height (50.01 cm) was in T₉, followed by T₈ (48.80 cm), while the minimum (20.38 cm) was in T₆. The superior performance of GA₃ may be attributed to enhanced cell division, cell elongation and mobilization of stored food reserves. The findings are in accordance with Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Seedling girth (mm)

The seedling girth showed significant variation among treatments at all growth stages (Table 2). At 30 DAS, seedling girth ranged from 0.82 to 1.23 mm. Highest girth (1.23 mm) was in T₉, whereas the lowest (0.82 mm) was in T₆. At 180 DAS, the maximum seedling girth (8.98 mm) was recorded in T₉, followed by T₈ (8.25 mm), while the minimum (5.01 mm) was in T₆. The increased girth under GA₃

may be attributed to enhanced cell division, vascular development and assimilate translocation. Similar findings were reported by Singh *et al.* (2015) [12], Sajana (2016) [9] and Meshram *et al.* (2015) [13].

Number of leaves per seedling

Data on number of leaves per seedling showed significant variation among the treatments (Table 3). At 30 DAS, the number of leaves ranged from 4.48 to 6.87. Maximum leaves (6.87) were recorded in T₉, followed by T₈ (6.80), whereas the minimum (4.48) was in T₆. At 180 DAS, T₉ recorded the highest leaves (15.47), followed by T₈ (15.43), while the lowest (12.28) was in T₆. The increased leaf production under GA₃ treatment may be attributed to enhanced GA₃ activity in the apical meristem, which promotes nucleoprotein synthesis and stimulates leaf initiation and expansion. Similar results were reported by Bhosale (2014) [7], Sajana (2016) [9] and Kale *et al.* (2025) [14] in marking nut.

Leaf area (cm²)

Data on leaf area of seedlings showed significant variation among the treatments (Table 3). At 30 DAS, leaf area ranged from 5.07 to 28.60 cm². Maximum leaf area (28.60 cm²) was recorded in T₉, followed by T₈ (23.77 cm²), whereas the minimum (5.07 cm²) was in T₆. At 180 DAS, the highest leaf area (183.67 cm²) was recorded in T₉, followed by T₈ (161.67 cm²), while the lowest (66.33 cm²) was observed in T₆. Higher leaf area under GA₃ treatment might be attributed to enhanced cell division, cell elongation and cell expansion induced by gibberellic acid, which ultimately resulted in greater leaf area. Similar results were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Primary root length (cm)

Data on primary root length showed significant variation among the treatments at 180 DAS (Table 4). Maximum primary root length (42.27 cm) was recorded in T₉, followed by T₈ (39.67 cm) and T₃ (37.60 cm), whereas the minimum (17.43 cm) was in T₁ (control). The enhanced root growth under GA₃ may be attributed to increased cell division and elongation in the root meristem and improved mobilization of stored food reserves. Similar findings were reported by Bhosale (2014) [7], Sajana (2016) [9] and Kale *et al.* (2025) [14] in marking nut.

Number of secondary roots

The number of secondary roots showed significant variation among the treatments at 180 DAS (Table 4). Maximum number of secondary roots (45.43) was in T₉, whereas minimum (18.33) was in T₆. The increased production of secondary roots under GA₃ may be attributed to enhanced root meristem activity, cell division and translocation of assimilates towards the developing root. Similar results were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Fresh shoots weight of seedling (g)

The fresh shoot weight showed significant variation among the treatments at 180 DAS (Table 4). Maximum fresh shoot weight (42.00 g) was recorded in T₉, whereas the minimum (10.00 g) was in T₆. Higher fresh shoot weight under GA₃ may be attributed to enhanced cell division, elongation and biomass accumulation. Similar results were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Dry shoots weight of seedling (g)

Data on dry shoot weight showed significant variation among the treatments at 180 DAS (Table 4). Maximum dry shoot weight (10.60 g) was recorded in T₉, whereas the minimum (1.65 g) was in T₆. Higher dry matter accumulation under GA₃ may be attributed to enhanced vegetative growth, photosynthetic activity and mobilization of stored reserves. Similar results were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Fresh roots weight of seedling (g)

The fresh root weight showed significant variation among the treatments at 180 DAS (Table 4). Maximum fresh root weight (139.97 g) was recorded in T₉, whereas the minimum (22.43 g) was in T₅. The increased root biomass under GA₃ may be attributed to enhanced cell division and elongation, resulting in vigorous root development. Similar findings were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Dry roots weight of seedling (g)

The dry root weight showed significant variation among the treatments at 180 DAS (Table 4). Maximum dry root weight (27.40 g) was recorded in T₉, whereas the minimum (4.40 g) was in T₆. Higher dry root weight under GA₃ may be attributed to greater translocation of photosynthates and nutrients towards the root system and enhanced root growth. Similar results were reported by Bhosale (2014) [7], Sajana (2016) [9] and Kale *et al.* (2025) [14] in marking nut.

Shoot:root ratio

The shoot:root ratio showed significant variation among the treatments at 180 DAS (Table 4). Maximum shoot:root ratio (0.57) was recorded in T₈, whereas the minimum (0.24) was in T₁ (control). Higher ratio under T₈ may be attributed to greater proportional allocation of dry matter towards shoot growth. Although T₉ recorded the highest shoot and root dry weights, its greater root biomass resulted in a comparatively lower shoot:root ratio. Similar findings were reported by Bhosale (2014) [7] and Sajana (2016) [9] in marking nut.

Absolute growth rate (cm/day) of seedling

Absolute growth rate varied among the treatments during different growth intervals (Fig. 2). Highest AGR during 30-60 DAS (0.6482 cm/day) and 90-120 DAS (0.3740 cm/day) was recorded in T₉. During 60-90 DAS, T₃ recorded the highest AGR (0.5377 cm/day), while T₈ recorded the highest value (0.2754 cm/day) during 120-150 DAS and T₇ recorded highest AGR (0.0880 cm/day) during 150-180 DAS. Higher AGR under GA₃ may be attributed to enhanced cell division, elongation and mobilization of stored food reserves. Similar findings were reported by Harshavardhan *et al.* (2012) [15] in jackfruit and Palepad *et al.* (2017) [16] in custard apple.

Relative growth rate (cm/cm/day)

Relative growth rate varied among treatments during different growth intervals (Fig. 3). The highest RGR during 30-60 DAS (0.0127 cm/cm/day) was recorded in T₆, while T₃ recorded the highest RGR during 60-90 DAS (0.0163 cm/cm/day). During 90-120 DAS, the maximum RGR (0.0100 cm/cm/day) was recorded in T₉, while T₈ recorded the highest RGR (0.0061 cm/cm/day) during 120-150 DAS and T₆ (0.0040 cm/cm/day) recorded highest RGR during 150-180 DAS. The higher RGR under GA₃ during the middle growth stages may be attributed to enhanced cell elongation, photosynthetic activity and dry matter accumulation. The higher early RGR in T₆ may be due to its smaller initial seedling size. Similar findings were reported by Palepad *et al.* (2017) [16] in custard apple.

Seedlings root volume (ml)

Data on root volume showed significant variation among treatments at 180 DAS (Table 4). Root volume ranged from 7.00 to 96.00 ml. Maximum root volume (96.00 ml) was in T₉, followed by T₃ (80.33 ml) and T₇ (65.00 ml), whereas the minimum (7.00 ml) was in T₆. The greater root volume under GA₃ may be attributed to enhanced cell division and elongation in the developing root tissues, along with stimulation of lateral root development, resulting in a more extensive roots and greater root volume. Similar results were reported by Hakimi (2020) [17] in avocado.

Seedling vigour index-I

The seedling vigour index-I showed significant variation among the treatments at 180 DAS (Table 1). Highest vigour index-I (6558.56) was recorded in T₉, followed by T₈ (5013.59) and T₇ (3728.61), whereas the lowest (565.83) was in T₆. Higher vigour index-I under GA₃ may be attributed to its combined effect on germination percentage and seedling growth through enhanced mobilization of seed reserves and cell elongation. Similar results were reported by Lalitha *et al.* (2020) [18] in aonla and Palepad *et al.* (2017) [16] in custard apple.

Seedling vigour index-II

The seedling vigour index-II showed significant variation among the treatments at 180 DAS (Table 1). Highest vigour index-II (2710.54) was recorded in T₉, followed by T₈ (1118.29) and T₇ (939.34), whereas the lowest (84.70) was in T₆. The superior vigour index-II under GA₃ may be attributed to enhanced germination and greater seedling dry matter accumulation through improved mobilization and

utilization of stored reserves. Similar findings were reported by Lalitha *et al.* (2020) [18] in aonla and Palepad *et al.* (2017) [16] in custard apple.

Economics of seedlings production

The highest seedling survival percentage was recorded in T₉ (90.42%) and lowest was observed in T₆ (72.14%). The cost of production was highest in T₄ (₹ 10837.12/-), while the minimum was noticed in T₁ (₹ 6452.12/-) (Table 5). The highest gross returns (₹ 19380.00/-) and net returns (₹ 9850.12/-) were recorded in T₉, whereas the lowest gross returns (₹ 3000/-) and net returns (₹ -7472.80/-) were recorded in T₆. However, the highest benefit:cost ratio (2.03) was recorded in treatment T₉, while the minimum benefit:cost ratio (0.28) was recorded in T₆. The superior economic performance of treatment T₉ may be attributed to its higher seedling survival percentage, which resulted in higher returns and ultimately the highest benefit:cost ratio.

Table 1. Effect of different pre-sowing seed treatments on seed germination, survival percentage and seedling vigour index in marking nut

Treatments	Days for germination (days)	Germination percentage (%)	Survival percentage (%)	Seedling vigour index-I	Seedling vigour index-II
T ₁ : Control- without treatment	25.33	15.33 (23.05)	76.35 (60.90)	672.71	236.59
T ₂ : Soaking seeds in normal water (24 hrs.)	20.00	36.67 (37.26)	81.06 (64.20)	2479.00	490.16
T ₃ : Hot water soaking for 20 min. (80°C)	18.67	40.00 (39.23)	86.33 (68.30)	3164.00	898.67
T ₄ : Scarification by conc. H ₂ SO ₄ for 1 min.	12.33	21.33 (27.50)	80.91 (64.08)	1987.58	405.98
T ₅ : Scarification by conc. H ₂ SO ₄ for 3 min.	12.00	18.00 (25.10)	74.26 (59.51)	1017.48	161.40
T ₆ : Scarification by conc. H ₂ SO ₄ for 5 min.	11.33	14.00 (21.97)	72.14 (58.14)	565.83	84.70
T ₇ : Soaking seeds in GA ₃ 50 ppm for 24 hrs.	19.00	51.33 (45.76)	84.48 (66.79)	3728.61	939.34
T ₈ : Soaking seeds in GA ₃ 100 ppm for 24 hrs.	16.00	56.67 (48.83)	88.42 (70.10)	5013.59	1118.29
T ₉ : Soaking seeds in GA ₃ 150 ppm for 24 hrs.	13.67	71.33 (57.62)	90.42 (71.96)	6558.56	2710.54
Mean	16.48	36.07	81.59	2798.60	782.85
SE. m ±	1.26	2.38	3.78	51.02	22.47
CD (P = 0.05)	3.77	7.13	11.32	152.97	67.37

Table 2. Effect of different pre-sowing seed treatments on subsequent seedlings height and girth in marking nut

Treatments	Seedlings height (cm)						Seedlings girth (mm)					
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS
T ₁ : Control- without treatment	10.27	14.27	16.96	21.13	24.70	26.45	1.02	2.25	3.51	4.13	5.24	6.05
T ₂ : Soaking seeds in normal water (24 hrs.)	12.89	16.35	25.56	32.29	34.76	36.20	1.06	2.39	3.56	4.81	5.73	6.71
T ₃ : Hot water soaking for 20 min. (80°C)	13.09	16.46	26.85	35.95	39.76	41.50	1.10	2.48	3.90	4.92	6.02	7.01
T ₄ : Scarification by conc. H ₂ SO ₄ for 1 min.	12.23	16.23	19.04	22.84	23.79	24.69	1.00	2.05	3.28	4.15	5.15	6.18

(continued on next page)

Treatments	Seedlings height (cm)						Seedlings girth (mm)					
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS
T ₅ : Scarification by conc. H ₂ SO ₄ for 3 min.	9.17	13.28	16.79	19.41	21.09	22.03	1.00	1.90	3.03	4.01	4.96	5.70
T ₆ : Scarification by conc. H ₂ SO ₄ for 5 min.	7.93	11.44	15.79	17.38	19.36	20.38	0.82	1.72	2.97	3.91	4.53	5.01
T ₇ : Soaking seeds in GA ₃ 50 ppm for 24 hrs.	15.23	19.29	26.77	34.26	37.97	40.61	1.12	2.41	3.57	5.04	6.65	7.48
T ₈ : Soaking seeds in GA ₃ 100 ppm for 24 hrs.	17.67	21.67	30.25	38.89	46.68	48.80	1.14	2.55	3.94	5.38	7.02	8.25
T ₉ : Soaking seeds in GA ₃ 150 ppm for 24 hrs.	18.11	23.11	31.78	43.00	48.11	50.01	1.23	2.73	4.13	5.69	7.10	8.98
Mean	12.95	16.9	23.31	29.46	32.91	34.51	1.05	2.27	3.54	4.67	5.82	6.81
SE. m ±	0.79	0.69	0.96	1.24	1.21	1.29	0.06	0.10	0.35	0.20	0.34	0.44
CD (P = 0.05)	2.36	2.06	2.89	3.70	3.64	3.86	0.17	0.31	1.04	0.61	1.03	1.33

Table 3. Effect of different pre-sowing seed treatments on number of leaves and leaf area in marking nut

Treatments	Number of leaves per seedling (Nos.)						Leaf area (cm ²)					
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS
T ₁ : Control- without treatment	4.50	5.17	7.33	9.84	11.48	12.82	5.17	28.00	43.33	66.33	75.33	83.00
T ₂ : Soaking seeds in normal water (24 hrs.)	5.33	6.17	8.77	10.84	12.38	13.67	15.87	44.67	57.33	78.67	98.33	113.33
T ₃ : Hot water soaking for 20 min. (80°C)	5.93	6.27	9.23	11.10	12.43	14.24	16.90	55.33	73.67	113.67	127.67	146.33
T ₄ : Scarification by conc. H ₂ SO ₄ for 1 min.	5.20	6.04	8.38	9.92	11.42	12.39	7.43	38.67	58.00	70.00	82.67	93.00
T ₅ : Scarification by conc. H ₂ SO ₄ for 3 min.	5.10	5.67	8.53	10.40	11.80	12.93	6.70	32.00	51.33	62.67	74.00	84.00
T ₆ : Scarification by conc. H ₂ SO ₄ for 5 min.	4.48	5.08	7.22	9.38	10.83	12.28	5.07	27.00	32.67	48.00	56.33	66.33
T ₇ : Soaking seeds in GA ₃ 50 ppm for 24 hrs.	6.10	6.90	9.60	11.83	13.50	15.10	20.57	64.67	81.33	125.67	138.67	153.33
T ₈ : Soaking seeds in GA ₃ 100 ppm for 24 hrs.	6.80	7.07	9.63	11.87	13.60	15.43	23.77	75.00	90.00	129.67	150.00	161.67
T ₉ : Soaking seeds in GA ₃ 150 ppm for 24 hrs.	6.87	7.73	10.53	12.50	13.77	15.47	28.60	85.33	113.00	156.67	171.67	183.67
Mean	5.59	6.23	8.80	10.85	12.35	13.81	14.45	50.07	66.74	94.59	108.29	120.51
SE. m ±	0.46	0.24	0.25	0.25	0.31	0.42	0.49	1.72	2.07	4.40	5.11	6.14
CD (P = 0.05)	1.38	0.73	0.74	0.74	0.92	1.25	1.48	5.14	6.20	13.19	15.32	18.41

Table 4. Effect of different pre-sowing seed treatments on shoot and root parameters in marking nut

Treatments	Primary root length (cm)	Number of secondary roots	Fresh shoots weight (g)	Dry shoots weight (g)	Fresh roots weight (g)	Dry roots weight (g)	Shoot:root Ratio	Seedlings root volume (ml)
T ₁ : Control- without treatment	17.43	23.00	14.50	3.03	43.00	12.40	0.24	29.00
T ₂ : Soaking seeds in normal water (24 hrs.)	31.07	27.00	16.00	3.57	53.03	9.80	0.36	40.33
T ₃ : Hot water soaking for 20 min. (80°C)	37.60	38.00	19.67	5.67	90.97	16.80	0.34	80.33
T ₄ : Scarification by conc. H ₂ SO ₄ for 1 min.	31.50	31.67	25.67	5.83	65.00	13.20	0.44	39.00

(continued on next page)

Treatments	Primary root length (cm)	Number of secondary roots	Fresh shoots weight (g)	Dry shoots weight (g)	Fresh roots weight (g)	Dry roots weight (g)	Shoot:root Ratio	Seedlings root volume (ml)
T ₅ : Scarification by conc. H ₂ SO ₄ for 3 min.	34.50	21.00	12.28	1.77	22.43	7.20	0.25	11.67
T ₆ : Scarification by conc. H ₂ SO ₄ for 5 min.	20.03	18.33	10.00	1.65	28.07	4.40	0.38	7.00
T ₇ : Soaking seeds in GA ₃ 50 ppm for 24 hrs.	32.03	32.67	23.33	5.10	80.20	13.20	0.39	65.00
T ₈ : Soaking seeds in GA ₃ 100 ppm for 24 hrs.	39.67	39.67	28.33	7.13	61.33	12.60	0.57	48.67
T ₉ : Soaking seeds in GA ₃ 150 ppm for 24 hrs.	42.27	45.43	42.00	10.60	139.97	27.40	0.39	96.00
Mean	31.78	30.75	21.30	4.92	64.88	13.00	0.37	46.33
SE. m ±	0.81	1.34	1.11	0.34	0.35	0.28	0.02	2.30
CD (<i>P</i> = 0.05)	2.42	4.01	3.32	1.01	1.04	0.83	0.07	6.88

Table 5. Effect of different pre-sowing seed treatments on economics of marking nut seedling production for 1000 seedlings based on final survival percentage

Treatments	Cost of production (Rs.)	Gross Returns (Rs.)	Net Returns (Rs.)	B:C ratio
T ₁ : Control- without treatment	6452.12	3390	-3062.1	0.52
T ₂ : Soaking seeds in normal water (24 hrs.)	7382.12	8970	1587.88	1.21
T ₃ : Hot water soaking for 20 min. (80°C)	7617.12	10380	2762.88	1.36
T ₄ : Scarification by conc. H ₂ SO ₄ for 1 min.	10837.12	5190	-5647.8	0.47
T ₅ : Scarification by conc. H ₂ SO ₄ for 3 min.	10637.8	3990	-6647.8	0.37
T ₆ : Scarification by conc. H ₂ SO ₄ for 5 min.	10472.8	3000	-7472.8	0.28
T ₇ : Soaking seeds in GA ₃ @ 50 ppm for 24 hrs.	8154.71	12780	4625.29	1.56
T ₈ : Soaking seeds in GA ₃ @ 100 ppm for 24 hrs.	8657.3	14970	6312.7	1.72
T ₉ : Soaking seeds in GA ₃ @ 150 ppm for 24 hrs.	9529.88	19380	9850.12	2.03

Note: Selling price of marking nut seedling: ₹30/-

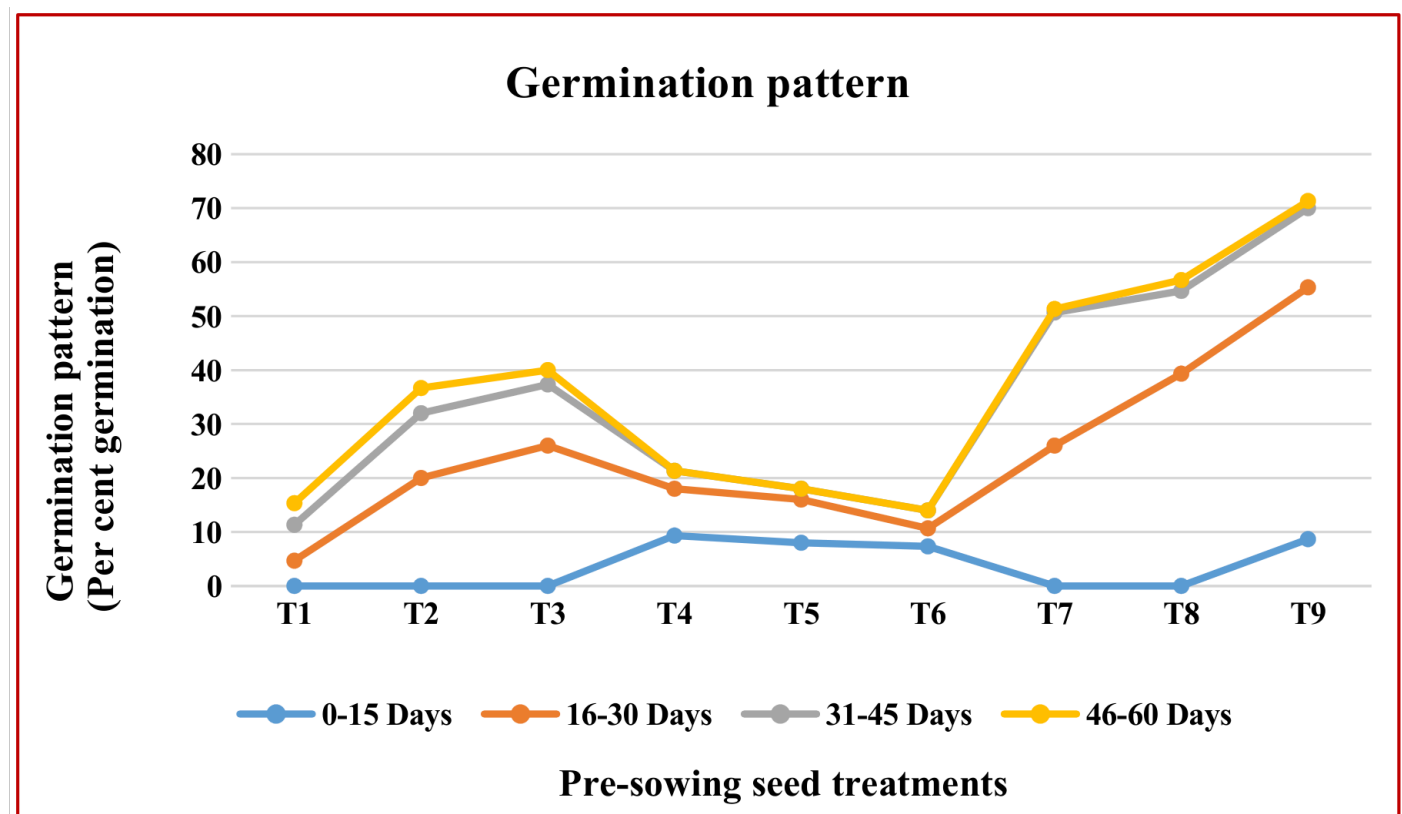


Figure 1. Effect of different pre-sowing seed treatments on seed germination pattern in marking nut

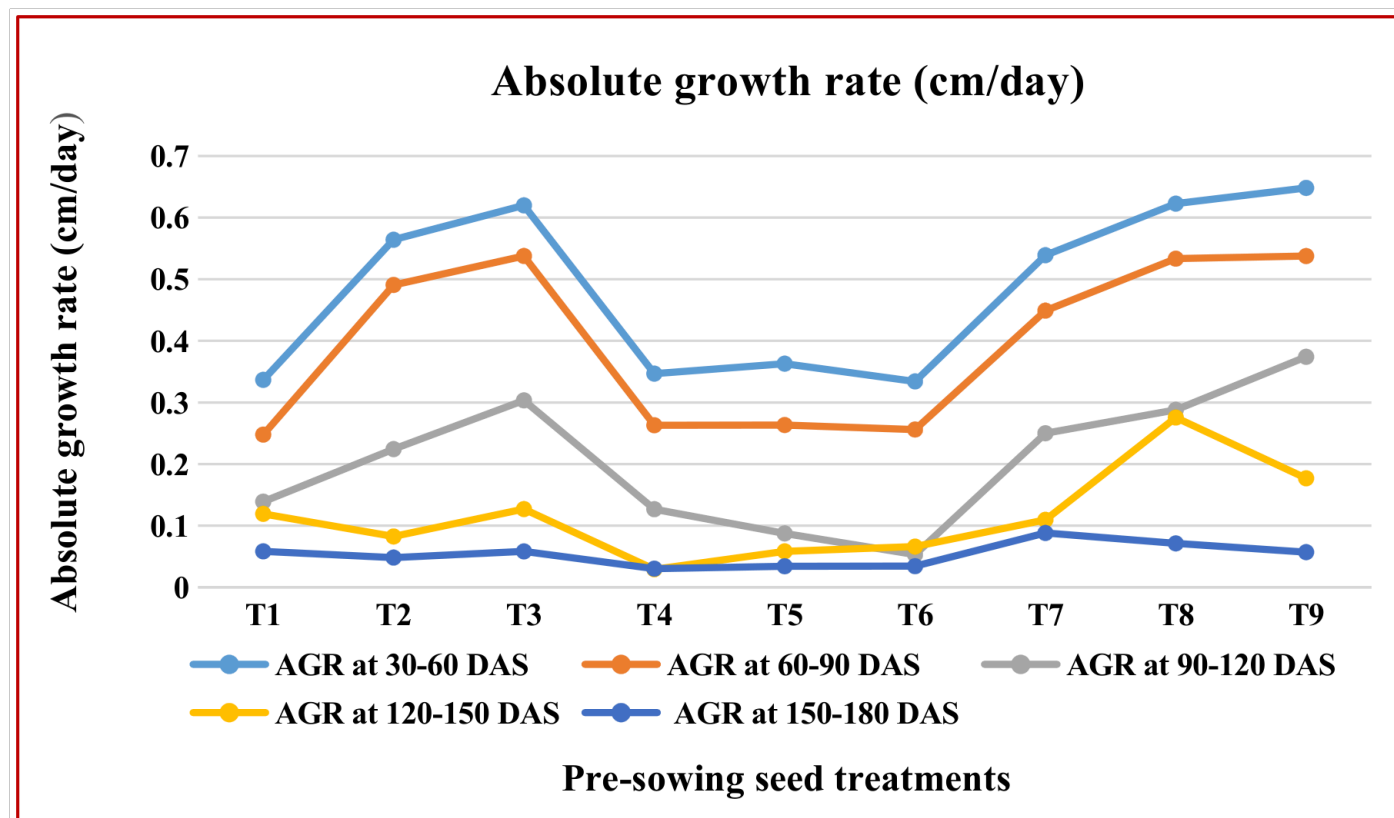


Figure 2. Effect of different pre-sowing seed treatments on absolute growth rate of marking nut seedling

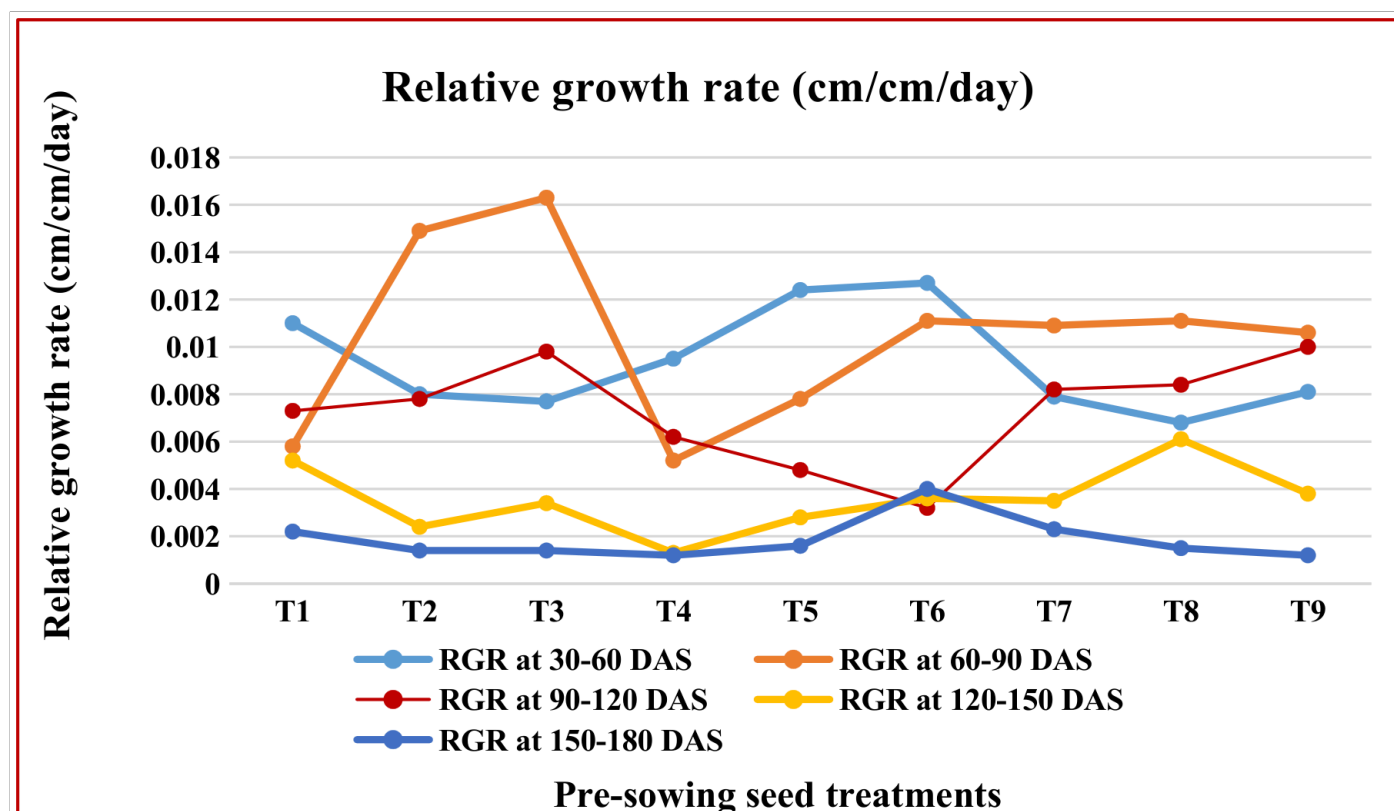


Figure 3. Effect of different pre-sowing seed treatments on relative growth rate of marking nut seedling

Conclusion

The present findings concluded that pre-sowing seed treatments significantly influenced seed germination, survival and seedling growth of marking nut. Among the treatments, T₉ (soaking seeds in GA₃ 150 ppm for 24 hrs) recorded the best overall performance with the highest germination (71.33%), survival (90.42%), seedling growth, biomass, root development and seedling vigour. It also resulted in the

highest net returns (₹9,850.12) and benefit:cost ratio (2.03). Treatment T₈ (Soaking seeds in GA₃ 100 ppm for 24 hrs) ranked next to T₉. Thus, GA₃ 150 ppm for 24 hours can be considered a promising pre-sowing seed treatment for producing vigorous marking nut seedlings. However, this is the one-year experiment data, therefore, further investigations under diverse environmental conditions and nursery situations are suggested to validate the effectiveness of this treatment on a larger scale.

Acknowledgments

This work is a part of M.Sc. research work, at College of Horticulture, DBSKKV, Dapoli, (M.S.), India. The authors are thankful to the Associate Dean and Dean, Faculty of Horticulture, DBSKKV, Dapoli and research guide for providing the facilities. Authors extend their sincere thanks to the colleagues of M.Sc. student, Department of Horticulture, Dapoli for their support in field data collection.

References

1. Upreti S, Anam MS, Rajendra SV, Das K, Dang R. *Semecarpus anacardium* - A wonderful plant with varied medicinal properties. Journal of Pharmaceutical Research. 2016;15(4):162.
2. Semalty M, Semalty A, Badola A, Joshi GP, Rawat MS. *Semecarpus anacardium* Linn.: A review. Pharmacognosy Reviews. 2010;4(7):88-94.
3. Vijay MK, Tiwari S, Kahar L, Malviya D, Aharwar M, Singh NA. Comprehensive review of nutritional, phytochemical and pharmacological properties of *Semecarpus anacardium* L.: A significant wild edible fruit species of central India. International Journal of Advanced Biochemistry Research. 2025;9(4):350-361.
4. Yang QH, Ye WH, Yin XJ. Dormancy and germination of *Areca triandra* seeds. Scientia Horticulturae. 2007;113(1):107-111.
5. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi. 1995:123-159.
6. Chatar KS, Harne SS, Deshmukh HK, Shambharkar VB, Ujjainkar VV, Ingole DN, Palaspagar PR. Analysis of various pre-sowing treatments on germination status of *Semecarpus anacardium* Linn. A Review Indian Journal of Traditional Knowledge. 2025;6(4):653-659.
7. Bhosale PS. Effect of different pre-soaking treatments on seed germination and growth of marking nut. M.Sc. Horti thesis submitted to College of Agriculture, Latur (unpublished). 2014.
8. Haque F, Singh N. Seed germination of *Semecarpus anacardium* L. under various treatment. Journal of Medicinal Plants Studies. 2022;10(2):1-4.
9. Sajana S. Studies on effect of plant growth regulators on seed germination and seedling growth of marking nut. M.Sc. Horti thesis submitted to College of Agriculture, Latur, Maharashtra (Unpublished). 2016.
10. Barche S, Kirad K, Singh DB. Response of seed treatment on germination, growth, survivability and economics of different cultivars of papaya (*Carica papaya* L.). Acta Horticulturae. 2010;851(851):279-284.
11. Banyal AK, Guleria T, Banyal SK. Improving seed germination and seedling growth of guava under protected conditions by pre-sowing chemical and hormonal seed treatments. Biological Forum—An International Journal. 2022;14(1):151-157.
12. Singh LS, Pariari A, Shukla G. Effect of panchagavya and GA3 on germination and seedling growth in cashew (*Anacardium occidentale* L.). Journal of Horticultural Sciences. 2015;10(2):245-249.
13. Meshram PC, Joshi PS, Bhojar RK, Sahoo AK. Effect of different plant growth regulators on seedling growth of acid lime. Research in environment and life sciences. 2015;8(4):725-728.
14. Kale I, Milkuri CR, Singh L, Rajendra P, Mhaskar MKN, Bhargavi CH, Ooha M, Rajashekar P. Effect of pre-sowing treatments on germination and growth of *Semecarpus anacardium* L. International Journal of Advanced Biochemistry. 2025;9(4):765-769.
15. Harshavardhan A, Rajasekhar M. Effect of pre-sowing seed treatments on seedling growth of jackfruit (*Artocarpus heterophyllus* Lam.). Journal of Research ANGRAU. 2012;40(4):87-89.
16. Palepad KB, Bharad SG, Bansode GS. Effect of seed treatments on germination, seedling vigour and growth rate of custard apple (*Annona squamosa*). Journal of pharmacognosy Phytochemistry. 2017;6(5):20-23.
17. Hakimi N. Study on effect of plant growth regulators and chemicals on seed germination of avocado (*Persea americana* Mill.). M.Sc Horti thesis submitted to University of Agricultural and Horticultural Sciences, Shivamogga (unpublished). 2020.
18. Lalitha KR, Tank RV, Chawla SL, Jena S. Effect of chemicals on seed germination and seedling growth of aonla (*Emblica officinalis* Gaertn.). Pharma Innovation Journal. 2020;9(12):239-243.

How to cite this article: Kadam PV, SL G, KV M, SB T, Palshetkar M. Effect of different pre-sowing seed treatments on seed germination and subsequent seedling growth of marking nut (*Semecarpus anacardium* L.) under Konkan agroclimatic condition. *International Journal of Agriculture and Food Science*. 2026;8(10):283-290. doi: <https://www.doi.org/10.33545/2664844X.2026.v8.i10d.2031>