Original Research Article

Influence of seed priming and growing medium on germination and seedling vigour of Tamarind (*Tamarindus indica* L.)

ABSTRACT

A field experiment was conducted in 2020–21 at the Fruit Research Station, Imaliya, Department of Horticulture, JNKVV, Jabalpur. The AFRBD (Asymmetrical Factorial Randomized Block Design) was set up with 20 distinct treatment combinations of soil mediaSoil + Sand, Soil + Vermicompost, Soil + Sand + Vermicompost, Soil +Vermicompost + Biofertisol, Soil + Vermicompost + Azatobactor + PSB + KSB and plant growth regulator*i.e.* GA_3 0 ppm (control), GA_3 100 ppm, GA_3 200 ppm, GA_3 300 ppm. The vigour and germination of seeds were significantly impacted by the type of media used and the usage of plant growth regulators. In regard to the growth parameter, better values for seedling height, number of leaves and stem girth at 30, 60 and 90 days after sowing were found with treatment GA_3 200 ppm. Growth metrics, such as root length, fresh shoot weight, dry shoot weight and dry root weight at 120 days, revealed improved results with a higher vigour index when the combination of GA_3 200 ppm + growing medium (soil+ vermicompost+ Biofertisol) were applied. The GA_3 200 ppm with growing medium (Soil+ Vermicompost+ Biofertisol) were proven to be better in terms of the seed germination parameters.Minimum time was taken for seed germination and increased seed germination percentage had been recorded at 30 days after planting.

Keywords: Growth, Tamarind, Germination, Growing media, GA_3, Vermicompost, Biofertisol

1. INTRODUCTION

Tamarind, also known as Imli, is a member of the Fabaceae family and Caesalpinoideae subfamily. It is a diploid species, and its 2n = 24 chromosome indicates this (Purseglove, 1987). The term "Indian Date" comes from the Arabic word "Tamarind-E-Hind," which means "Date of India." Tamarind is derived from this word.The potential expansion of the tamarind's habitat range beyond its naturalised territories in Africa and India into South East Asia and Latin America has been noticed, indicating a gradual movement towards areas characterised by diminished dry periods and increased precipitation(Bowe & Haq, 2010).

A 30-meter-tall tamarind tree has a small trunk, several stems and a lengthy lifespan. It is an enormous species of evergreen or semi-evergreen tree. Its trunk is around 8 metres in circumference and its crown may be up to 12 metres in diameter. 13–14 years after planting, it begins to give fruit (Lewis and Neelakantan, 1964). It has a lifespan of up to 200 years and can continue to produce for more than 50 years (Hernandez-Unzon and Lakshmi Narayana, 1982).

Whereas almost every constituent of the plant is utilised in the food, chemical, pharmaceutical, textile, fodder, wood and fuel industries. Tamarind is assuming a unique place in social, urban and agro-forestry as a result of its numerous industrial, pharmacological and commercial uses. Many items, including tamarind juice, concentrate, powder, pickles and paste, may be made from its pulp (Caluwe*et al*., 2010). The fruit's primary ingredients are pulp and seeds. The tamarind pulp is extensively employed in the production of foods and drinks for both household and commercial consumption. The mature fruit's makeup is composed of 30–50% pulp, 11–30% shell and fibre and 25–40% seed. Tartaric acid, reducing sugars, pectin, protein, fibre and cellulose components are all present in the fruit's pulp. Minerals including potassium, calcium, phosphorus, magnesium and salt are abundant in fruit pulp (Almeida *et al*., 2009). With an output of 1.97 MT and a production area of 47,000 ha, India is the world's greatest producer of tamarind (Anonymous 2020). Tamil Nadu, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Kerala are the states that produce the most tamarind. The seed is traditionally used to spread tamarind and epigeal seed germination is the method used. Due to seed dormancy, the main disadvantage of seed propagation is that newly collected seeds have a low germination rate even when they have all favourable condition for germination. This might be as a result of physical traits like hard, thick testes or from improper handling or storage practises (secondary dormancy). These seeds need particular treatments including scarification, stratification, growth regulators, biofertilizers and soaking in water to break their dormancy. Chemical pre-sowing seed treatments with GA_3, KNO_3, NAA and thiourea (Rajamanickam *et al*., 2002). Bio-fertilizers such as Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria and Vesicular Arbuscular Mycorrhiza fungi (VAM) enhance seed germination and seedling growth by producing a variety of growth regulators such as Indole Acetic Acid (IAA), Gibberellic Acid (GA) and vitamins (Fallick *et al*., 1989 and Ruan *et al*., 1973).Germination rates of tamarind seeds in cold and arid environments may be significantly enhanced with pre-sowing treatments, such as soaking in hot water, application of plant growth regulator and stratification (Kumar *et al*., 2019). For transplanting in the field, 10-12 month old tamarind seedlings are preferred.

2. MATERIAL AND METHODS

The study was conducted with seeds of local grown tamarind tree in polybags into well managed Polyhouse at Fruit Research Station, Imalia, Depratment of Horticulture, College of Agriculture, Jabalpur during 2021-22.All the seeds for experiment were taken from single mother plant. Altogether, there were twenty treatments with three replications using 30 polybags as a treatment unit in

Factorial Randomized Block Design (FRBD). The experiment was consisted of two factors i.e. PGR(Plant growth regulator) with different doses of GA_3which denoted as T1, T2, T3, T4and growing mediawhich denoted as M1, M2, M3, M4, M5. In PGR there was a four levels T_1(GA_3 0 ppm control), T_2(GA_3 100 ppm), T_3 (GA_3 200 ppm) and T_4 (GA_3 300 ppm) in which seeds were soaked prior to sowing in polybags. For soaking the seeds we have taken 100, 200 and 300 mg of GA_3 andtransferred them separately into different glass beakers. For dissolving the growth regulators, a few drops of 95% ethyl alcohol were added just to dissolve the growth regulators. After that volume was made up of 1000ml with distilled water in each glass beaker.After volume makeup seed were soaked into it for 24 hoursthen sown in different growing media which are taken assecond factor growing media consist of M_1[Soil+Sand(1:1)], M_2[Soil+Vermicompost(1:1)], M_3[Soil + Sand+ Vermicompost (1:1:1)], M_4[Soil +Vermicompost + Biofertisol(1:1:50ml)], M_5[Soil + Vermicompost+ Azatobactor+ PSB+ KSB (1:1 : 10ml : 10m :10ml)]. There was 20 treatment as a resultant of combinations of these two factors T_1M_1 (Control+Soil+ Sand), T_1M_2 (Control + Soil + Vermicompost), T_1M_3 (Control +Soil + Sand + Vermicompost), T_1M_4 (Control + Soil + Vermicompost + Biofertisol), T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB), T_2M_1 (GA_3 100 ppm + Soil + Sand), T_2M_2 (GA_3 100 ppm + Soil + Vermicompost), T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost), T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol), T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB), T_3M_1 (GA_3 200 ppm + Soil + Sand), T_3M_2 (GA_3 200 ppm + Soil + Vermicompost), T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost), T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol), T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB), T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost), T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost), T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol), T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB). Tamarind seeds were sowed at a depth of 2-2.5 cm in polythene bags previously filled with different growing media. Twenty polythene (40cm X 30 cm with 200 gauge)bags were used for each treatment.

During the experiment germination parametersie.days taken to first germination, days taken to 50 % germination and percent germination at 30 day after sowing were estimated from the date of sowing. Growth parameters viz. seedling height at 30, 60, 90, 120 DAS (Days after sowing) was measured with the help of scale from base of seedling to the tip of growing shoot, number of leaves per seedling at 30, 60, 90 DAS were counted manually and stem girth was measured with the help of vernier calliper.Length of roots was measured from the collar region to the tip of the root with the help of a ruler and recorded at 120 days after sowing.Electronic weighing machine was used for fresh weight of shoot, dry weight of shoot, fresh weight of root, dry weight of root. Leaf area was measured with the help of leaf area meter.Parameters like germination %, seedling vigour index I at 120 days, seedling vigour index II at 120 days and survival percentage at 120 days were calculated by following formula:

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

Seedling Vigour Index I = Germination (%) x(Root length + Shoot length in cm)

Seedling vigour index II = Dry weight of seedlings (g) × Germination (%)

$$\text{Survival (\%)} = \frac{\text{No. of survived seedling}}{\text{Total number of seedlings}} \times 100$$

3. RESULTS AND DISCUSSION

All the treatments showed significant impact over germination as well as growth parameters.

3.1 Effect of plant growth regulator:

The results indicated that seed treatment with GA_3 had a significant impact on germination attributes. Soaking seeds in GA_3 200 ppm showed the earliest germination (6.05 days), minimum number of days (11.75) for 50% seed germination and highest rate of seed germination (92.89%) whereas treatment T_1 (control) showed the longest germination (10.82 days), maximum number of days (15.76) required for 50% seed germination and lowest rate of seed germination (75.88%). It is possible that the increased availability of starch assimilation was brought on by GA_3, which would have stimulated the activity of certain enzymes that encouraged early germination, such as -amylase. Parameshwari and Srimathi (2008), Sharma *and Jain* (2016) and Samir *et al*. (2015) have all reported on similar studies.The considerable impact of gibberellic acid on seed germination may be attributable to its involvement in alpha-amylase activity, which catalyses the conversion of starch into simple carbohydrates and releases chemical energy that is needed to activate the embryo. Pawar *et al*. (2010) reported a comparable outcome.

The results showed that seed treatment with GA_3 at a concentration of 200 ppm, was most successful in increasing seedling height to 12 cm, 15.98 cm, 20.17 cm, and 38.38 cm, at 30, 60, 90 and 120 DAS, respectively. It may be because of seeds treated for 24 hours resulted speed up the rate of complex sugars being hydrolysed into simple sugars, which are then used to synthesise auxins and proteins. The use of proteins in the synthesis of new tissues and the growth-promoting effects of auxins are widely recognised.Due to the hormone GA_3, which promotes nutrient osmotic absorption and causes cell elongation, treatment with GA_3 lengthens seedlings (Shanmugavelu, 1966). similarly Nimbalkar, *et al*. (2012) also reported in Karonda.

The highest number of leaves per seedling (6.08, 18.76 and 22.01), stem girth (2.38, 2.69 and 2.79 mm) at 30, 60 and 90 DAS, respectively and leaf area (17.46 cm^2) at 120 days after sowing, were recorded with the treatment T_3 (GA_3 200 ppm). The increase may be caused by cell division and increased apical meristem activity, both of which may be aided by growth hormones (Mishra *et al.*, 2017). The increase in leaf count may also be related to the fact that GA_3 helps to revitalise physiological plant processes and the stimulatory effect of chemicals to form new leaves at a faster rate, as reported by Pawar *et al.* (2010).

Maximum root length (29.47 cm), fresh weight of the shoot (8.72 g), dry weight of the shoot (2.62 g), fresh weight of the root (1.29 g), dry weight of the root (0.97 g), seedling vigour index -I (2775.04), seedling vigour index-II (333.64) and survival percent of the seedling (95%) at 120 DAS, were all obtained with treatment T_3 (GA_3 200 ppm). Since the plant increases through two processes—cell division by mitosis, which produces new cells and elongation of existing cells by enlarging the vacuoles—growth of the plant occurs by both cell division and enlargement. The maximum length and greater number of roots observed under the treatments may be due to the fact that they absorbed more food material. Swamy *et al.* (1999), Ramteke *et al*. (2015), and Kalalbandi*et al*. (2003) all reported this discovery. The effects of GA_3 on various plant portions result in an increase in the fresh weight of shoots, which may be attributable to its promotion of cell division, cellular and auxin metabolism, cell wall flexibility and cell membrane permeability effects, all of which aid in enhanced development. Ramteke *et al*. (2015) and Hota *et al*. (2018) reported in Jamun. Gibberellic acid's the function in the mobilisation, translocation and accumulation of water and nutrients transported at a higher rate that may have encouraged more photosynthetic product production in various plant parts may have contributed to the maximum dry weight of the seedling with GA_3. Dhankar and Singh (1996) observed that GA_3 had a comparable impact on seedling dry weight. Ramteke *et al.* (2015) had independently confirmed with this finding.

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3.2 Effect of Soil medium:

It was clear from the result that the treatment M_4 (Soil + Vermicompost + Biofertisol) recorded the lowest number of days required for seed germination (7.83), days taken to 50 % germination (12.81), and the highest germination percentage at 30 DAS (86.49%), whereas treatment M_1 (Soil + Sand) recorded the highest number of days (9.35) taken for seed germination and days taken (14.65) to 50 % germination and the lowest germination percentage (82.76%). The results also indicated that the highest seedling height of 11.40 cm, 15.05 cm, 19.26 cm and 36.68 cm at 30, 60, 90 and 120 DAS, respectively, the maximum number of leaves per seedling (6.12, 17.46 and 21.29), stem girth (2.09, 2.75 and 2.87 mm) at 30, 60 and 90 days after sowing, respectively, the maximum leaf area (21.16 cm^2) at 120 days after sowing , the maximum root length (29.80 cm), fresh (9.07 g) and dry weight of shoot (2.54 g), fresh (1.21 g) and dry weight of root (0.89 g), seedling vigour index I (2624.19), seedling vigour index II (300.02) and survival percent of seedling (92.29%) at 120 days after sowing were measured in treatment M_4 (Soil + Vermicompost + Biofertisol). While the lowest values of these characters are recorded with treatment M_1 i.e. growing media (soil +sand).

According to Kaur (2017) this may be attributable to the presence of vermicompost in the media, which has a balanced composition of nutrients that aids in plant germination and growth. The application of vermicompost had greatly influenced the height of the tomato plant (Pushpa, 1996).According to Parasana*et al.* (2013) applying growth media resulted in an increase in the number of leaves, which may be attributable to enhanced nutrient availability that boosted the development of photosynthetically functioning leaves. Adding vermicompost enhances the physical and biological conditions, improve soil aeration and increases permeability, which creates an ideal environment for development and biomass. This outcome agreed with Prajapati *et al.* (2017) in acid lime and Chaudhary *et al.* (2018) in papaya.

Additionally the exogenous proline or proline analogues can promote plant growth and development, proline precursor rich FPH has been targeted as a potential seed vigour inducer (Milazzo *et al*., 1999). According to the findings, FPH-stimulated increased phenolic synthesis may assist seedling growth and lignification activities for germination stress resistance. The support of the proline-linked PPP by FPH-derived amino acids is the mechanism by which FPH enhances phenolic content also reported by Shetty, 1997 and 2004).

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3.3 Interaction effect of plant growth regulator and soil medium:

The germination characters, growth parameters and seed vigour were significantly affected by the interaction of growing media and plant growth regulators. The results showed that the interaction of seed soaking in 200 ppm GA_3 and use of growing media (Soil+ Vermicompost + Biofertisol) resulted in the lowest number of days required for seed germination (5.09), days taken to 50 % germination (10.71), highest germination percentage (94.56%) at 30 DAS, maximum heights of 13.40 cm, 17.33 cm, 19.28 cm and 35.87 cm at 30, 60, 90 and 120 days after sowing, respectively, increase in the number of leaves per seedling, stem girth (2.95, 3.76 and 4.44 mm) at 30, 60, and 90 days after sowing and leaf area (24.39 cm^2) at 120 days after sowing, increased length of root (32.71 cm), fresh weight of shoot (10.48 g), dry weight of shoot (3.14 g), fresh weight of root (1.50 g), dry weight of root (1.13 g), seedling vigour index I (3128.84), seedling vigour index II (403.62), survival per cent of seedling (96.76%) at 120 days after sowing. While the lowest values of germination attributes, growth characters and the seed vigour were recorded with treatment T_1M_1 i.e. interaction of seed soaking with GA_3 0 ppm and growing media (soil +sand).

The considerable impact of gibberellic acid on seed germination may be attributable to its involvement in alpha-amylase activity, which catalyses the conversion of starch into simple carbohydrates and releases chemical energy that is needed to activate the embryo. Pawar *et al*. (2010) and Yadav *et al*. (2018) reported a comparable outcome. It is also possible that the increased

availability of starch assimilation was brought on by GA_3, which would have stimulated the activity of certain enzymes that encouraged early germination, such as -amylase. Parameshwari and Srimathi (2008), Sharma and Jain (2016) and Samir *et al*. (2015) have all reported on similar studies. Gibberellic Acid play significant role in cell division, cell elongation and cell multiplication that stimulate the cambium and its immediate cell progeny, increase the collar diameter. The activity of certain enzymes that benefited in early germination, including amylase, would have been stimulated by the presence of GA_3, which would have increased the availability of starch absorption. The findings suggested that the growing number of leaves may be related to GA_3 activity at the apical meristem, which increased the synthesis of the nucleoprotein necessary for growing leaf initiation.

Also the vermicompost is believed to contain bioactive elements that are advantageous for root development, potentially leading to increased root initiation, elevated germination rates, greater biomass, and enhanced overall growth and development (Bachman and Metzger, 2008). It has been suggested that the well-decomposed organic matter in vermicompost could contribute to a balanced nutrient composition, helping to retain soil moisture, boost nutrient levels, and enhance soil structure. These effects may improve water absorption, sustain cell turgidity, facilitate cell elongation, and optimize respiration, creating favorable conditions for seed germination. (Zaller, 2007).

In addition to this the exogenous proline and/or proline analogues can promote plant growth and development, proline precursor rich FPH has been targeted as a potential seed vigour inducer (Milazzo *et al.,* 1999). Hori *et al*.,2007 suggested an ability of proline precursor-rich FPH to improve of plant growth and development (e.g., seed vigour) in phenolic-rich plant species through modulation of phenolic and chlorophyll metabolisms.

Table 1 : Effect of seed priming and growing media on germination characters of tamarind

Treatment	Days taken to first germination	Days taken to 50% germination	Percent of germination of 30 DAS
Factor A			
T_1 (Control)	10.82	15.76	75.88
T_2 (GA_3 100 ppm)	8.17	13.73	88.60
T_3 (GA_3 200 ppm)	6.05	11.75	92.89
T_4 (GA_3 300 ppm)	9.79	14.42	80.45
SEm (±)	0.036	0.035	0.259
CD (*P* = .05)	0.104	0.100	0.743
Factor B			
M_1 (Soil+Sand)	9.35	14.65	82.76
M_2 (Soil+Vermicompost)	9.15	14.42	83.14
M_3 (Soil+Sand+ Vermicompost)	8.97	14.15	84.51
M_4 (Soil+Vermicompost+ Biofertisol)	7.83	12.81	86.49
M_5 (Soil+Vermicompost+ Azatobactor +PSB+KSB)	8.25	13.55	85.38
SEm (±)	0.041	0.039	0.290
CD (*P* = .05)	0.116	0.112	0.831
Interaction effect (Factor A X B)			
T_1M_1 (Control+Soil+ Sand)	11.25	16.84	74.19
T_1M_2 (Control + Soil + Vermicompost),	11.18	16.31	74.81
T_1M_3 (Control +Soil + Sand + Vermicompost),	11.15	16.08	75.66
T_1M_4 (Control + Soil + Vermicompost + Biofertisol)	10.16	14.29	78.56
T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB)	10.37	15.26	76.16
T_2M_1 (GA_3 100 ppm + Soil + Sand),	8.84	14.18	85.85
T_2M_2 (GA_3 100 ppm + Soil + Vermicompost),	8.65	14.12	86.24
T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost),	8.55	13.97	88.76
T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol),	7.15	12.85	91.34
T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	7.65	13.52	90.79
T_3M_1 (GA_3 200 ppm + Soil + Sand)	7.05	12.35	91.45
T_3M_2 (GA_3 200 ppm + Soil + Vermicompost),	6.63	12.21	91.57
T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost),	6.20	12.02	93.00
T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol),	5.09	10.71	94.56
T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	5.27	11.47	93.89
T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	10.26	15.22	79.54
T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	10.13	15.05	79.95
T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost)	9.98	14.51	80.60
T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol)	8.91	13.39	81.50
T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB).	9.69	13.94	80.67
SEm (±)	0.081	0.078	0.580
CD (*P* = .05)	0.232	0.224	1.661

Table 2 : Effect of seed priming and growing media on seedling height of Tamarind

Treatment	30 DAS (cm)	60 DAS (cm)	90 DAS (cm)	120 DAS (cm)
Factor A				
T_1 (Control)	8.87	11.44	15.01	26.73
T_2 (GA_3 100 ppm)	10.02	14.03	18.02	32.98
T_3 (GA_3 200 ppm)	12.00	15.98	20.17	38.38
T_4 (GA_3 300 ppm)	9.30	13.00	17.58	31.21
SEm (±)	0.069	0.055	0.063	0.037
CD (*P* = .05)	.0198	0.158	0.120	0.107
Factor B				
M_1 (Soil+Sand)	8.99	12.52	16.61	27.71
M_2 (Soil+Vermicompost)	9.28	12.82	16.88	29.98
M_3 (Soil+Sand+ Vermicompost)	9.88	13.28	17.43	32.81
M_4 (Soil+Vermicompost+ Biofertisol)	11.40	15.05	19.26	36.68

M_5 (Soil+Vermicompost+ Azatobactor +PSB+KSB)	10.69	14.41	18.30	34.44
SEm (±)	0.077	0.062	0.070	0.042
CD (*P* = .05)	0.221	0.177	0.201	0.119
Interaction effect (Factor A X B)				
T_1M_1 (Control+Soil+ Sand)	7.38	10.25	13.94	22.70
T_1M_2 (Control + Soil + Vermicompost),	7.86	10.79	14.04	24.20
T_1M_3 (Control +Soil + Sand + Vermicompost),	8.74	11.16	14.60	27.70
T_1M_4 (Control + Soil + Vermicompost + Biofertisol)	10.70	12.75	16.62	30.63
T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB)	9.68	12.23	15.84	28.40
T_2M_1 (GA_3 100 ppm + Soil + Sand),	9.01	13.04	16.84	27.40
T_2M_2 (GA_3 100 ppm + Soil + Vermicompost),	9.28	13.26	17.16	30.33
T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost),	9.84	13.66	17.70	33.20
T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol),	11.21	15.40	19.67	38.33
T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	10.76	14.80	18.71	35.62
T_3M_1 (GA_3 200 ppm + Soil + Sand)	10.91	15.07	19.26	34.87
T_3M_2 (GA_3 200 ppm + Soil + Vermicompost),	11.27	15.17	19.68	36.60
T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost),	11.75	15.83	20.01	38.72
T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol),	13.40	17.33	21.45	41.87
T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	12.66	16.52	20.44	39.83
T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	8.65	11.72	16.40	25.88
T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	8.68	12.04	16.63	28.80
T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost)	9.20	12.45	17.38	31.62
T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol)	10.30	14.71	19.28	35.87
T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB).	9.66	14.07	18.21	33.90
SEm (±)	0.154	0.123	0.140	0.083
CD (*P* = .05)	0.442	0.353	0.402	0.238

Table 3: Effect of seed priming and growing media on growth characters (number of leaves per seedling, stem girth and leaf area) of Tamarind

Treatment	Number of leaves			Stem girth (mm)			Leaf area (cm^2)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
Factor A							
T_1 (Control)	4.02	14.24	18.31	2.38	2.69	2.79	12.51
T_2 (GA_3 100 ppm)	5.01	16.26	20.32	2.47	3.12	3.32	14.82
T_3 (GA_3 200 ppm)	6.08	18.76	22.01	2.60	3.28	3.68	17.46
T_4 (GA_3 300 ppm)	4.42	15.05	19.24	2.40	2.92	3.10	13.66
SEm (±)	0.046	0.060	0.036	0.015	0.044	0.007	0.046
CD (*P* = .05)	0.132	0.171	0.104	0.042	0.127	0.019	0.130
Factor B							
M_1 (Soil+Sand)	3.84	15.02	19.02	2.09	2.75	2.87	11.03
M_2 (Soil+Vermicompost)	4.35	15.42	19.31	2.26	2.87	3.03	11.68
M_3 (Soil+Sand+ Vermicompost)	4.69	15.72	19.67	2.48	3.02	3.17	12.52
M_4 (Soil+Vermicompost+ Biofertisol)	6.12	17.46	21.29	2.84	3.28	3.69	21.16
M_5 (Soil+Vermicompost+ Azatobactor +PSB+KSB)	5.42	16.77	20.56	2.64	3.10	3.35	16.69
SEm (±)	0.052	0.067	0.041	0.016	0.050	0.007	0.051
CD (*P* = .05)	0.147	0.191	0.117	0.047	0.142	0.021	0.146
Interaction effect (Factor A X B)							
T_1M_1 (Control+Soil+ Sand)	2.63	13.35	17.48	1.99	2.54	2.58	9.01
T_1M_2 (Control + Soil + Vermicompost),	3.55	13.72	17.87	2.16	2.65	2.71	9.62
T_1M_3 (Control +Soil + Sand + Vermicompost),	3.76	13.99	18.11	2.40	2.71	2.84	10.10
T_1M_4 (Control + Soil + Vermicompost + Biofertisol)	5.65	15.42	19.36	2.88	3.00	3.02	18.17
T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB)	4.50	14.71	18.72	2.48	2.55	2.82	15.63
T_2M_1 (GA_3 100 ppm + Soil + Sand),	4.16	15.35	19.37	2.15	2.82	2.98	11.08
T_2M_2 (GA_3 100 ppm + Soil + Vermicompost),	4.55	15.74	19.67	2.27	2.96	3.14	11.73
T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost),	4.88	16.02	20.06	2.46	3.17	3.26	12.46
T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol),	6.03	17.55	21.66	2.81	3.43	3.84	22.45
T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	5.45	16.62	20.84	2.68	3.24	3.36	16.41
T_3M_1 (GA_3 200 ppm + Soil + Sand)	5.25	17.52	20.81	2.23	2.94	3.14	13.59
T_3M_2 (GA_3 200 ppm + Soil + Vermicompost),	5.55	18.07	21.11	2.39	3.06	3.26	14.29
T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost),	5.87	18.57	21.47	2.58	3.19	3.45	15.72
T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol),	7.15	20.20	23.65	2.95	3.76	4.44	24.39
T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	6.60	19.47	22.99	2.84	3.45	4.12	19.33
T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	3.34	13.87	18.41	2.00	2.70	2.78	10.42
T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	3.76	14.14	18.57	2.24	2.80	3.02	11.08
T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost)	4.23	14.30	19.05	2.46	3.01	3.15	11.80
T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol)	5.65	16.66	20.47	2.73	2.95	3.44	19.61
T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB).	5.13	16.26	19.68	2.56	3.15	3.09	15.39
SEm (±)	0.103	0.134	0.081	0.033	0.099	0.015	0.102
CD (*P* = .05)	0.295	0.383	0.233	0.094	0.284	0.043	0.291

Table 4: Effect of seed priming and growing media on length of root, fresh weight of shoot, dry weight of shoot, fresh weight of root and dry weight of root of Tamarind at 120 DAS

Treatment	Root length (cm)	Fresh Weight of Shoot (g)	Dry Weight of Shoot (g)	Fresh Weight of root (g)	Dry Weight of root (g)
Factor A					
T_1 (Control)	23.19	6.45	1.61	0.84	0.59
T_2 (GA_3 100 ppm)	27.54	7.99	2.32	1.02	0.75
T_3 (GA_3 200 ppm)	29.47	8.72	2.62	1.29	0.97
T_4 (GA_3 300 ppm)	26.38	7.01	1.93	0.96	0.70
SEm (±)	0.093	0.060	0.017	0.013	0.01
CD (*P* = .05)	0.267	0.172	0.048	0.036	0.03
Factor B					
M_1 (Soil+Sand)	23.07	6.40	1.83	0.85	0.63
M_2 (Soil+Vermicompost)	25.01	6.78	1.90	0.93	0.69
M_3 (Soil+Sand+ Vermicompost)	26.56	7.23	2.02	1.05	0.77
M_4 (Soil+Vermicompost+ Biofertisol)	29.80	9.07	2.54	1.21	0.89
M_5 (Soil+Vermicompost+ Azatobactor +PSB+KSB)	28.79	8.23	2.30	1.09	0.80
SEm (±)	0.104	0.067	0.019	0.014	0.01
CD (*P* = .05)	0.298	0.192	0.054	0.041	0.03
Interaction effect (Factor A X B)					
T_1M_1 (Control+Soil+ Sand)	20.45	5.61	1.40	0.66	0.46
T_1M_2 (Control + Soil + Vermicompost),	21.57	5.95	1.49	0.71	0.50
T_1M_3 (Control +Soil + Sand + Vermicompost),	22.32	6.30	1.58	0.85	0.60
T_1M_4 (Control + Soil + Vermicompost + Biofertisol)	26.33	7.59	1.90	1.06	0.74
T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB)	25.28	6.78	1.69	0.93	0.65
T_2M_1 (GA_3 100 ppm + Soil + Sand),	23.77	6.93	2.01	0.82	0.60
T_2M_2 (GA_3 100 ppm + Soil + Vermicompost),	25.77	7.33	2.13	0.93	0.69
T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost),	27.97	7.54	2.19	1.11	0.82
T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol),	30.58	9.52	2.76	1.18	0.88
T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	29.60	8.62	2.50	1.04	0.77
T_3M_1 (GA_3 200 ppm + Soil + Sand)	25.45	7.45	2.24	1.15	0.86
T_3M_2 (GA_3 200 ppm + Soil + Vermicompost),	27.92	7.69	2.31	1.23	0.92
T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost),	29.41	8.40	2.52	1.26	0.94
T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol),	32.71	10.48	3.14	1.50	1.13
T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	31.86	9.58	2.88	1.33	1.00
T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	22.60	5.62	1.69	0.79	0.58
T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	24.78	6.16	1.66	0.87	0.63
T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost)	26.53	6.68	1.80	0.97	0.71
T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol)	29.57	8.68	2.34	1.11	0.81
T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB).	28.42	7.92	2.14	1.07	0.78
SEm (±)	0.208	0.134	0.038	0.028	0.02
CD (*P* = .05)	0.597	0.384	0.108	0.081	0.06

Table 5 : Effect of seed priming and growing media on seedling vigour Index-I, Index- II and survival percentage of Tamarind seed at 120 DAS

Treatment	Seedling vigour index-I	Seedling vigour index-II	Survival percentage
Factor A			

T_1 (Control)	1791.88	167.39	82.30
T_2 (GA_3 100 ppm)	2477.32	272.62	93.02
T_3 (GA_3 200 ppm)	2775.04	333.64	95.00
T_4 (GA_3 300 ppm)	2155.31	211.70	91.39
SEm (±)	10.055	1.575	0.008
CD (*P* = .05)	28.788	4.508	0.027
Factor B			
M_1 (Soil+Sand)	1951.40	206.45	88.66
M_2 (Soil+Vermicompost)	2124.46	217.65	89.34
M_3 (Soil+Sand+ Vermicompost)	2292.73	238.93	90.40
M_4 (Soil+Vermicompost+ Biofertisol)	2624.19	300.02	92.29
M_5 (Soil+Vermicompost+ Azatobactor +PSB+KSB)	2506.66	268.65	91.45
SEm (±)	11.242	1.761	0.009
CD (*P* = .05)	32.186	5.041	0.027
Interaction effect (Factor A X B)			
T_1M_1 (Control+Soil+ Sand)	1545.30	138.23	78.64
T_1M_2 (Control + Soil + Vermicompost),	1641.50	148.48	80.43
T_1M_3 (Control +Soil + Sand + Vermicompost),	1717.86	164.19	82.38
T_1M_4 (Control + Soil + Vermicompost + Biofertisol)	2099.29	207.26	85.45
T_1M_5 (Control + Soil + Vermicompost + Azotobacter + PSB + KSB)	1955.45	178.79	84.61
T_2M_1 (GA_3 100 ppm + Soil + Sand),	2071.82	224.50	92.57
T_2M_2 (GA_3 100 ppm + Soil + Vermicompost),	2254.10	242.98	92.78
T_2M_3 (GA_3 100 ppm + Soil + Sand + Vermicompost),	2514.35	266.97	93.06
T_2M_4 (GA_3 100 ppm + Soil + Vermicompost + Biofertisol),	2826.16	332.16	93.40
T_2M_5 (GA_3 100 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	2720.20	296.51	93.31
T_3M_1 (GA_3 200 ppm + Soil + Sand)	2360.46	282.99	93.76
T_3M_2 (GA_3 200 ppm + Soil + Vermicompost),	2590.08	295.69	93.98
T_3M_3 (GA_3 200 ppm + Soil + Sand + Vermicompost),	2769.21	322.03	94.85
T_3M_4 (GA_3 200 ppm + Soil + Vermicompost + Biofertisol),	3128.84	403.62	96.76
T_3M_5 (GA_3 200 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB),	3026.62	363.88	95.66
T_4M_1 (GA_3 300 ppm + Soil + Sand), T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	1828.04	120.07	89.68
T_4M_2 (GA_3 300 ppm + Soil + Vermicompost)	2012.18	183.45	90.16
T_4M_3 (GA_3 300 ppm + Soil + Sand + Vermicompost)	2169.52	202.54	91.33
T_4M_4 (GA_3 300 ppm + Soil + Vermicompost + Biofertisol)	2442.48	257.03	93.55
T_4M_5 (GA_3 300 ppm + Soil + Vermicompost + Azotobacter + PSB + KSB).	2324.35	235.43	92.24
SEm (±)	22.485	3.521	0.017
CD (*P* = .05)	64.371	10.081	0.053

4. CONCLUSION

It proved that individual impact of seed priming treatment T3 (GA3 200 ppm) and growing media M4 (Soil+ Vermicompost.+ Biofertisol) was found superior to the other treatments in terms of the observational days required for the first seed to germinate, days required for 50% germination, the percentage of germination, seedling height, the number of leaves per seedling, stem girth,

fresh weight of the shoot, dry weight of the shoot, fresh weight of the root, length of the root, leaf area, seedling vigour index I and seedling vigour index II. Whereas, interaction effect with regard to all germination and growth-related measures were found to be superior with treatment combination T3M4 i.e. (GA3 200 ppm) + (Soil + Vermicompost + Biofertisol).

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