International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(5): 617-622
www.biochemjournal.com
Received: 05-03-2024
Accepted: 10-04-2024

Shivani Kumari
M.Sc. (Hort.) Fruit Science, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Dr. Vijay Bahadur
Associate Professor & Head, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Dr. Annjoe V Joseph
Assistant Professor, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Shivani Kumari
M.Sc. (Hort.) Fruit Science, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Effect of different growing media on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Pusa Nanha and establishment percentage in high density planting (HDP) under Prayagraj agro-climatic condition

Shivani Kumari, Dr. Vijay Bahadur and Dr. Annjoe V Joseph

DOI: https://doi.org/10.33545/26174693.2024.v8.i5h.1144

Abstract
The present research work was carried out during August 2023 to October 2023 in Shade net house and October 2023 to December 2023 in main field condition of Horticulture Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh. The 1st phase of this research work was based on effect of different growing media on seed germination and seedling growth of papaya. And for this the experiment was conducted with thirteen treatments and three replications in Randomized Block Design (RBD). The treatments were T_0 Control (Soil), T_1 {Pond Soil (80%) + Vermicompost (10%) + Perlite (10%)}, T_2 {Pond Soil (60%) + Vermicompost (20%) + Perlite (20%)}, T_3 {Pond Soil (40%) + Vermicompost (30%) + Perlite (30%)}, T_4 {Pond Soil (70%) + Vermicompost (10%) + Vermiculite (10%) + Perlite (10%)}, T_5 {Pond Soil (40%) + Vermicompost (20%) + Vermiculite (20%) + Perlite (20%)}, T_6 {Pond Soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perlite (30%)}, T_7 {Soil (100%) + Biocapsule @ 500 ppm}, T_8 {Pond Soil (80%) + Vermicompost (10%) + Perlite (10%) + Biocapsule @ 500 ppm}, T_9 {Pond Soil (60%) + Vermicompost (20%) + Perlite (20%) + Biocapsule @ 500 ppm}, T_{10} {Pond Soil (40%) + Vermicompost (30%) + Perlite (30%) + Biocapsule @ 500 ppm}, T_{11} {Pond Soil (70%) + Vermicompost (10%) + Vermiculite (10%) + Perlite (10%) + Biocapsule @ 500 ppm}, T_{12} {Pond Soil (40%) + Vermicompost (20%) + Vermiculite (20%) + Perlite (20%) + Biocapsule @ 500 ppm}, T_{13} {Pond Soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perlite (30%) + Biocapsule @ 500 ppm}. The treatment T_{13} {Pond Soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perlite (30%) + Biocapsule @ 500 ppm} gives the best result in terms of initiation of Germination (8.87 days), Complete germination (17.73 days), Germination Percentage (96.23%), number of leaves per seedling (9.53), length of leaves (13.06), breadth of leaves (11.73), Leaf Area (169.28), seedling height (30.13), seedling girth (2.62), Chlorophyll Content (41.07), Fresh Weight of Seedling (9.36 g), Dry Weight of Seedling (1.13 g), and control group (T_0) consistently exhibited the lowest values across all parameters measured. The 2nd phase of this research work based on establishment and survivability of *Pusa Nanha* in High Density Planting (HDP) under Prayagraj agro-climatic condition.

Keywords: Papaya, growth, vermicompost, perlite, vermiculite, Biocapsule etc.

Introduction
Papaya (*Carica papaya* L.) is a member of the Caricaceae family and originates from tropical America. It is naturally diploid with a chromosome count of 2n=18. Additionally, it is used as a filler plant in orchards. This fruit is a significant crop in tropical and sub-tropical regions.

Papaya is highly nutritious and medicinal, packed with valuable nutrients, notably abundant in Vitamin A and C. The dried latex of papaya, commonly known as papain, is a powerful enzyme derived from the papaya fruit.

Commercial propagation of papaya primarily relies on seeds. Papaya seeds exhibit slow, erratic, and incomplete germination due to the presence of inhibitors, mainly phenolic compounds, in the gelatinous sarcotesta (aril or integument) surrounding the seed. This sarcotesta hampers germination. The slow and asynchronous germination is attributed due to presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat.

Various species, characterized as trioecious, exhibits three fundamental sexual forms: female, male, and hermaphrodite. Male plants do not produce any fruit. Typically, fruits from female plants are shorter, while those from hermaphrodite plants are longer. The seeds develop in a mixture of female and hermaphrodite plants.

Pond soil, abundant in organic matter, is both cost-effective and easily accessible. These soils boast a balanced mixture of sand, silt, and clay, enhancing their ability to support vegetation in various ways.

Vermicomposts, which are produced by the fragmentation of organic wastes by earthworms, have a fine particulate structure and contain nutrients in forms that are readily available for plant uptake.

Perlite and Vermiculite having good aeration and drainage, they can retain and hold substantial amount of water and later release it as needed. Non-toxic, with a neutral pH, easily accessible, and possessing a relatively unstable nature.

Biocapsule is a new tools for the sustainable farming. It plays a very significance role by providing the nutrients absorption present in the applied organic manures. The nutrients present in the manures are readily available to plants for their proper growth and development.

Materials and Methods

My research work was carried out during August 2023 to October 2023 in Shade net house and October 2023 to December 2023 in main field condition of Horticulture Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh. The 1st phase of this research work was based on effect of different growing media on seed germination and seedling growth of papaya. And for this the experiment was conducted with thirteen treatments and three replications in Randomized Block Design (RBD).

Treatment Combinations

T_0: Soil (Control), T_1: Pond Soil (80%) + Vermicompost (10%) + Perlite (10%), T_2: Pond Soil (60%) + Vermicompost (20%) + Perlite (20%) T_3: Pond Soil (40%) + Vermicompost (30%) + Perlite (30%), T_4: Pond Soil (70%) + Vermicompost (10%) + Vermiculite (10%) + Perlite (10%), T_5: Pond Soil (40%) + Vermicompost (20%) + Vermiculite (20%) + Perilite (20%), T_6: Pond Soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perlite (30%), T_7: Soil (100%) + Biocapsule @ 500 ppm, T_8: Pond Soil (80%) + Vermicompost (10%) + Perilite (10%) + Biocapsule @ 500 ppm, T_9: Pond Soil (60%) + Vermicompost (20%) + Perilite (20%) + Biocapsule @ 500 ppm, T_{10}: Pond Soil (40%) + Vermicompost (30%) + Perilite (30%) + Biocapsule @ 500 ppm, T_{11}: Pond Soil (70%) + Vermicompost (10%) + Vermiculite (10%) + Perilite (10%) + Biocapsule @ 500 ppm, T_{12}: Pond Soil (40%) + Vermicompost (20%) + Vermiculite (20%) + Perilite (20%) + Biocapsule @ 500 ppm, T_{13}: Pond Soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perilite (30%) + Biocapsule @ 500 ppm

The research was carried out with the objectives of studying the effect of different growing media on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Pusa Nanha and establishment percentage in High Density Planting (HDP).

Data Collection

Five plants were selected from each treatment, and their growth, development, and establishment parameters were recorded.

Result and Discussion

[a]. Germination Parameters

1) Number of days required for initiation of germination

The minimum time taken for germination initiation was 8.87 days in treatment T_{13}, comprising Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely was treatment T_{12}, with 9.67 days required for germination, utilizing Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the maximum duration for germination initiation was 15.63 days in treatment T_0, where only soil was used as a control.

The utilization of vermicompost and biocapsules significantly reduced the days to germination initiation in papaya. Vermicompost, rich in nutrients and beneficial microorganisms, enhanced soil fertility and provided a favorable environment for seed germination. Biocapsules, containing essential nutrients and growth-promoting substances, facilitated quicker seed activation and germination. Both amendments expedited the germination process by optimizing soil conditions and supplying vital resources, thereby shortening the time required for papaya seeds to initiate germination. This study is supported by similar findings of Atiyeh *et al.* (2000) [4].

2) Number of days required for complete germination:

The shortest duration for complete germination was 17.73 days in treatment T_{13}, comprising Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this, treatment T_{12} required 19.07 days for complete germination, utilizing Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the longest duration for complete germination was 27.48 days in treatment T_0, where only soil was used as a control.

The findings of this study are corroborated by Atiyeh *et al.* (2000) [4] & Atilla *et al*. (2015) [3], who similarly observed that employing various growing media improves overall germination rates.

3) Germination percentage (%)

The highest germination percentage was observed in treatment T_{13}, comprising Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this was treatment T_{12}, with Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the lowest germination percentage was recorded in treatment T_0, which solely utilized soil as a control.

The utilization of vermicompost, perlite, vermiculite, and biocapsules significantly enhanced complete germination in papaya. Vermicompost enriched soil with nutrients, perlite and vermiculite improved soil structure, while biocapsules provided growth-promoting substances. This combination created an optimal environment for papaya seeds to germinate fully, resulting in increased germination success. This research is bolstered by the congruent discoveries of Acharjee *et al.* (2015) [1].

[B]. Growth and Development parameters

1) Number of leaves per seedling

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the highest number of leaves per seedling (6.07, 7.00, and 9.53 respectively) was observed in treatment T_{13}, which consisted of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this trend, treatment T_{12}, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm, showed slightly lower numbers of leaves (5.47, 6.47, and 8.67 respectively). In contrast, the lowest number of leaves (3.23, 4.23, and 6.25 respectively) was recorded in treatment T_0, utilizing only soil as a control.

Vermicompost, enriched with essential nutrients courtesy of earthworm activity, fortifies soil structure and fertility, fostering robust papaya growth. Biocapsules introduce beneficial microorganisms, enhancing nutrient absorption and root health. This synergistic combination optimizes the papaya's physiological processes, resulting in increased leaf production. The enriched soil nurtures vigorous foliage growth, contributing to a healthier and more productive papaya plant. This study is backed by the analogous results found by Atilla *et al.* (2015) [3] and Dash *et al.* (2019) [8].

2) Length of leaves per seedling (cm)

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the longest length of leaves per seedling (8.00, 12.16, and 13.06 cm respectively) was observed in treatment T_{13}, consisting of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this trend, treatment T_{12}, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm, showed slightly shorter lengths of leaves (7.55, 10.65, and 12.73 cm respectively). Conversely, the shortest length of leaves (3.46, 5.58, and 6.90 cm respectively) was recorded in treatment T_0, utilizing only soil as a control.

The combination of vermicompost, pond soil, vermiculite, perlite, and biocapsules forms an ideal environment for papaya cultivation. Vermicompost boosts soil nutrients, while pond soil aids in moisture retention and mineral supply. Vermiculite and perlite improve soil aeration and drainage. Biocapsules introduce beneficial microbes, enhancing nutrient absorption. This nutrient-rich, well-draining substrate fosters robust root growth and overall plant vitality, resulting in heightened leaf production in papaya plants. This study is supported by the similar findings of Atilla *et. al*. (2015) [3], & Priyanka *et al.*, (2022).

3) Breadth of leaves (cm)

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the widest breadth of leaves per seedling (6.19, 8.33, and 11.73 cm respectively) was observed in treatment T_{13}, consisting of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this trend, treatment T_{12}, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm, showed slightly narrower breadths of leaves (5.93, 8.05, and 10.73 cm respectively). Conversely, the narrowest breadth of leaves (3.03, 3.89, and 5.12 cm respectively) was recorded in treatment T_0, utilizing only soil as a control.

The synergy of pond soil, vermicompost, vermiculite, perlite, and biocapsules cultivates prime conditions for robust plant growth, notably expanding leaf breadth. Pond soil delivers vital nutrients, vermicompost enriches soil texture and fertility, while vermiculite and perlite facilitate optimal moisture levels and air circulation. Biocapsules introduce beneficial microbes, enhancing nutrient absorption and overall plant vitality. This holistic approach fosters lush foliage, optimizing the plant's ability to harness sunlight for photosynthesis. This study is reinforced by the comparable findings of Atilla *et al*. (2015) [3] and Priyanka *et al*. (2022).

4) Leaf Area (cm^2)

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the maximum leaf area (48.20, 75.63, and 169.28 cm^2 respectively) was observed in treatment T_{13}, consisting of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following this trend, treatment T_{12}, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm, showed slightly smaller leaf areas (47.48, 74.01, and 162.44 cm^2 respectively). Conversely, the minimum leaf area (19.17, 24.97, and 82.47 cm^2 respectively) was recorded in treatment T_0, utilizing only soil as a control. This growing media combination encouraging cell division and elongation in leaf tissues. Consequently, more cells are produced and expanded, leading to increased leaf area. This study is bolstered by the analogous findings of Bhagat *et al.* (2014) [19].

5) Seedling Height (cm)

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the tallest seedling heights were observed in treatment T_{13}, with measurements of 15.01 cm, 22.01 cm, and 30.13 cm respectively. Treatment T_{13} consisted of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely were the seedling heights in treatment T_{12}, which measured 14.81 cm, 20.95 cm, and 29.39 cm respectively. Treatment T_{12} comprised Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the shortest seedling heights were recorded in treatment T_0, with measurements of 5.48 cm, 11.05 cm, and 18.77 cm respectively. Treatment T_0 utilized only soil as a control.

Vermicompost, abundant in nutrients, combined with vermiculite and perlite, known for their excellent water retention abilities, along with Biocapsules, which facilitate the swift availability of nutrients, synergistically promote plant height growth. This blend provides essential nutrients, maintains optimal soil moisture levels, and ensures efficient nutrient absorption, culminating in enhanced vertical plant growth. Biocapsule improved root system allows the plant to access more nutrients and water from the soil, which in turn supports vigorous vegetative growth, ultimately resulting in taller plants. This study is supported by the similar findings reported by Barche *et al.* (2012) [5].

6) Seedling Girth (mm)

At 15 days after germination (DAG), 30 DAG, and 45 DAG, the widest seedling girths were observed in treatment T_{13}, measuring 1.84 mm, 2.32 mm, and 2.62 mm respectively. Treatment T_{13} consisted of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely were the seedling girths in treatment T_{12}, measuring 1.81 mm, 2.21 mm, and 2.51 mm respectively. Treatment T_{12} comprised Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the narrowest seedling girths were recorded in treatment T_0, measuring 1.30 mm, 1.59 mm, and 1.89 mm respectively. Treatment T_0 utilized only soil as a control. In papaya seedling girth growth, the process is driven by a combination of cellular activities and hormonal regulation. This study is reinforced by the analogous results found by Kaur, (2017) [21].

7) Chlorophyll Content

The highest chlorophyll content (41.07) was observed in treatment T_{13}, which included Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely was treatment T_{12}, with a chlorophyll content of 39.38, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the lowest chlorophyll content (27.44) was recorded in treatment T_0, which utilized only soil as a control.

This treatment plays a crucial role in improving chlorophyll content within plants by enhancing nutrient uptake and bolstering overall plant health. Chlorophyll, pivotal for photosynthesis, requires essential nutrients like nitrogen, magnesium, and iron for its synthesis. With the introduction of beneficial microbes and improved nutrient availability, biocapsules optimize nutrient absorption, thereby fostering chlorophyll production. Consequently, this boosts chlorophyll content, enhances photosynthetic activity, and promotes the development of healthier, greener plants. This study is reinforced by the analogous results found by Bhardwaj, (2014) [6].

8) Fresh Weight of Shoot (gm)

The highest fresh weight (9.36 g) was observed in treatment T_{13}, consisting of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely was treatment T_{12}, with a fresh weight of 9.07 g, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the lowest fresh weight (3.59 g) was recorded in treatment T_0, which utilized only soil as a control.

This study is backed by Paikra *et al.*, (2021) [11] similar findings, indicating that utilizing various growing media has a positive impact on the fresh weight of papaya seedlings.

9) Dry Weight of Shoot (gm)

The highest dry weight (1.13 g) was observed in treatment T_{13}, which consisted of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perlite (30%), and Biocapsule at 500 ppm. Following closely was treatment T_{12}, with a dry weight of 1.03 g, comprising Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. In contrast, the lowest dry weight (0.27 g) was recorded in treatment T_0, which utilized only soil as a control.

This study is supported by similar findings from Kaur (2014), Choudhary *et al*. (2018), Paikra *et al*. (2021) [11], and Jiya and Wilson (2020), suggesting that employing different growing media positively influences the dry weight of papaya seedlings.

In main field condition

C] Effect of different spacing on vegetative parameters at 90 DAP (Days after Planting)

In field conditions, the highest yields were observed with a spacing of 1.25 x 1.25 meters, resulting in optimal values across all parameters: 18.32 leaves, 220.87 cm2 leaf area, 60.87 cm plant height, 8.68 mm plant girth, and 75.78 chlorophyll content. Following closely, the 1.50 x 1.50 meter spacing exhibited slightly lower results: 16.50 leaves, 218.96 cm2 leaf area, 58.92 cm plant height, 7.98 mm plant girth, and 72.59 chlorophyll content. Conversely, the least favorable outcomes were observed with a spacing of 1 x 1 meter, with minimal values in number of leaves (14.21), leaf area (208.54 cm2), plant height (56.23 cm), plant girth (6.01 mm), and chlorophyll content (66.78). This study is supported by the comparable findings of Nair, Juliya, and Mathew (2005) [17].

[D]. Survival percentage in the main field at different spacing:

Under field conditions, the highest survival percentage was achieved with a spacing of 1.25 x 1.25 meters, reaching 90.76%. Following closely, the 1.50 x 1.50 meter spacing exhibited a survival percentage of 89.24%. Conversely, the lowest survival percentage was observed with a spacing of 1 x 1 meter, resulting in a survival percentage of 86.23%.

Table 1: Effect of different growing media on different parameters of papaya (*Carica papaya*) cv. Pusa Nanha

Symbol	Germination Initiation (days)	Complete germination (days)	Germination percentage (%)	Number of leaves per seedling			Length of leaves (cm)			Breadth of leaves (cm)		
				15 DAG	30 DAG	45 DAG	15 DAG	30 DAG	45 DAG	15 DAG	30 DAG	45 DAG
T_0	15.63	27.48	65.47	3.23	4.23	6.25	3.46	5.58	6.90	3.03	3.89	5.12
T_1	13.40	26.00	70.34	3.60	4.67	6.53	6.13	7.37	8.42	4.73	5.29	6.13
T_2	12.92	25.25	74.76	4.17	5.22	6.67	7.14	8.06	9.21	5.13	5.60	6.49
T_3	12.42	24.02	79.28	4.33	5.33	6.98	7.54	8.87	10.07	5.22	6.00	6.94
T_4	12.04	22.51	86.31	4.71	5.71	6.80	6.43	8.37	9.66	5.44	6.34	7.43
T_5	10.93	21.00	90.38	5.00	6.00	7.07	6.58	8.63	9.78	5.32	6.18	7.55
T_6	10.47	20.27	92.12	5.20	6.13	8.00	7.25	10.65	12.51	5.61	7.01	9.44
T_7	14.63	26.25	67.57	3.77	4.77	7.02	4.10	6.00	7.43	3.34	4.20	5.76
T_8	13.28	25.93	72.74	3.93	5.07	6.93	6.75	9.14	10.85	5.09	5.94	7.35
T_9	12.69	24.76	84.20	4.44	5.44	6.82	5.16	7.46	9.92	4.98	5.79	7.16
T_{10}	12.29	23.36	81.69	4.42	5.42	7.04	7.03	9.01	10.78	5.35	6.24	8.35
T_{11}	11.67	21.73	89.87	4.93	5.73	6.87	6.41	8.05	9.99	5.53	6.74	8.57
T_{12}	9.67	19.07	94.12	5.47	6.47	8.67	7.55	11.14	12.73	5.93	8.05	10.73
T_{13}	8.87	17.73	96.23	6.07	7.00	9.53	8.00	12.16	13.06	6.19	8.33	11.73
F test	S	S	S	S	S	S	S	S	S	S	S	S
SE(d)	0.20	0.20	11.55	0.17	0.19	0.19	0.40	0.36	0.41	0.10	0.11	0.23
C.D. (5%)	0.42	0.42		0.35	0.39	0.39	0.82	0.75	0.84	0.20	0.22	0.48
CV	2.05	1.06	15.15	4.64	4.19	3.23	7.64	5.15	4.95	2.36	2.10	3.66
Symbol	**Leaf Area (cm2)**			**Seedling height (cm)**			**Seedling girth (mm)**			**Chlorophyll content**	**Fresh weight of shoot (gm)**	**Dry weight of shoot (gm)**
	15 DAG	30 DAG	45 DAG	15 DAG	30 DAG	45 DAG	15 DAG	30 DAG	45 DAG	45 DAG	45 DAG	45 DAG
T_0	19.17	24.97	82.47	5.48	11.05	18.77	1.30	1.59	1.89	27.44	3.59	0.27
T_1	31.44	45.11	122.90	5.80	12.03	22.31	1.63	1.94	2.20	30.35	4.51	0.45
T_2	36.27	52.95	125.68	7.11	12.84	23.41	1.58	1.87	2.16	30.79	4.90	0.51
T_3	40.89	56.48	132.14	9.85	14.59	23.74	1.68	2.00	2.30	31.79	6.23	0.62
T_4	45.50	60.96	137.93	12.49	16.36	24.46	1.69	2.00	2.29	35.50	7.28	0.69
T_5	46.27	67.95	145.35	14.03	18.89	27.73	1.69	1.98	2.26	37.95	8.53	0.85
T_6	46.76	70.14	150.23	14.47	20.77	28.51	1.74	2.05	2.34	38.48	8.83	0.91
T_7	19.83	29.70	95.19	5.71	11.74	19.64	1.39	1.71	2.01	28.47	3.78	0.35
T_8	33.95	50.35	118.80	6.27	12.38	22.95	1.65	1.97	2.32	30.38	4.71	0.53
T_9	38.12	58.81	127.68	8.14	13.67	23.63	1.63	1.96	2.28	31.17	5.49	0.60
T_{10}	43.03	64.60	134.51	11.26	15.40	23.92	1.60	1.94	2.23	33.71	6.70	0.64
T_{11}	45.72	70.09	140.57	13.24	17.89	26.29	1.65	1.94	2.23	37.23	8.13	0.76
T_{12}	47.48	74.01	162.44	14.81	20.95	29.39	1.81	2.21	2.51	39.38	9.07	1.03
T_{13}	48.20	75.63	169.28	15.01	22.01	30.13	1.84	2.32	2.62	41.07	9.36	1.13
F test	S	S	S	S	S	S	S	S	S	S	S	S
SE(d)	0.47	0.81	1.66	0.22	0.33	0.18	0.04	0.05	0.06	0.21	0.07	0.03
C.D. (5%)	0.97	1.68	3.43	0.45	0.68	0.37	0.08	0.11	0.12	0.43	0.15	0.06
CV	1.49	1.74	1.54	2.62	2.56	0.89	2.83	3.24	3.01	0.76	1.32	5.49

Table 2: Effect of different spacing on vegetative parameters and survival percentage at 90DAP in the main field of papaya (*Carica papaya*) cv. Pusa Nanha

Spacing distance	Number of leaves	Leaf area (cm^2)	Plant height (cm)	Plant girth (mm)	Chlorophyll content	Survival %
1 X 1 m	14.21	208.54	56.23	6.01	66.78	86.23
1.25 X 1.25 m	18.32	220.87	60.87	8.68	75.78	90.76
1.50 X 1.50 m	16.50	218.96	58.92	7.98	72.59	89.24
1.75 X 1.75 m	15.49	217.99	57.54	6.78	70.34	89.00

Conclusion

T_{13}, utilizing a mixture of Pond Soil (10%), Vermicompost (30%), Vermiculite (30%), Perilite (30%), along with Biocapsule at 500 ppm, consistently yielded the best outcomes across all parameters, which includes minimum days for initiation of germination, minimum days for complete germination, maximum germination percentage, maximum number of leaves per seedling, maximum length of leaves per seedling, maximum breadth of leaves per seedling, maximum leaf area, maximum seedling height, maximum seedling girth, maximum chlorophyll content, maximum fresh weight, maximum dry weight of papaya (*Carica papaya* L.) cv. Pusa Nanha. Following closely behind was T_{12}, composed of Pond Soil (40%), Vermicompost (20%), Vermiculite (20%), Perlite (20%), and Biocapsule at 500 ppm. Conversely, the least favorable results were observed with T_0 Soil (Control). In field conditions, the maximum results were achieved with a spacing of 1.25 x 1.25 m across all aspects, while the minimum results were associated with a spacing of 1 x 1 m.

References

1. Acharjee K, Sangma DK, Mishra DK, Deb P, Sinha B. Effect of some Schiff base ligands and their Zn(II) complexes on germination and seedling growth of papaya (*Carica papaya* L.). Indian J Adv Chem Sci. 2015;3(2):141-146.
2. Arvind K, Patel R, Upadhyay NV. Effect of different growing media containers on germination and establishment of seedlings of papaya (*Carica papaya* L.) cv. Madhu bindu. Trends Biosci. 2015;8(1):227-235.
3. Atilla A, Bülent Y, Furuzan A. Effects of three different concentrations of vermicompost on the growth in the

aged seedlings of Anatolian black pine. Int J Agric Forestry Fish. 2015;3(2):25-31.
4. Atiyeh RM, Subler S, Edwards CA, Bachman G, Metzger JD, Shuster W. Effects of vermicomposts and composts on plant growth in horticultural container media and soil. Pedobiologia. 2000;44:579-590.
5. Barche S, Singh Kirad K, Singh DB. Response of seed treatment on germination, growth, survivability and economics of different cultivars of papaya (*Carica papaya* L.). Acta Hort. 2010;851:279-284.
6. Bhardwaj RL. Effect of growing media on seed germination and seedling growth of papaya cv. 'Red lady'. Afr J Plant Sci. 2014;8(4):178-184.
7. Bowiya KS, *et al*. Effect of presoaking treatments on *in vitro* seed germination of papaya to facilitate axenic explant production. Int J Curr Microbiol Appl Sci. 2019;7(4):50-55.
8. Dash BP, Deepanshu, Singh D. Effect of different growing media on seed germination and subsequent seedling growth of papaya (*Carica papaya* L.) cv. Pusa Nanha under Prayagraj agro-climatic conditions. J Pharmacogn Phytochem. 2019;8(5):141-143.
9. Devi PY, Topno ES. Effects of Nano Chitosan and Bio capsule on growth, yield and quality of chili (*Capsicum annum* L.) in Poly-House condition. Int J Plant Soil Sci. 2022;34(23):662-670. Article no. IJPSS.92851. ISSN: 2320-7035.
10. Hafiz MMH, Anuar IMS, Ismail S. Effects of different media on germination, growth performance and biomass of papaya seedlings at nursery stage. Trans. Malaysian Soc. Plant Physiology. 2017;24. ISBN 978-967-10840-6-9.
11. Paikra P, Paikra MS, Netam A. Effect of giberellic acid and growing media on seed germination, growth and vigour of papaya (*Carica papaya* L.) seedling. The Pharma Innovation Journal. 2021;10(12):2343-2347.
12. Sharon TP, Kerketta A, Topno SE, Gouse SM, Tripathi P. Effect of Nano Zeolite, Nano Micronutrients and Biocapsules on Plant Growth, Head Yield and Quality of Broccoli (*Brassica oleracea* var Italica). International Journal of Environment and Climate Change. 2022;12(11):58-65. Article no. IJECC.88834. ISSN: 2581-8627.
13. Bali RS, Chauhan DS, Todaria NP. Effect of growing media, nursery beds and containers on seed germination and seedling establishment of *Terminalia bellirica* (Gaertn.) Roxb a multipurpose tree. Tropical Ecology. 2011;54(1):5-66. 2013 ISSN 0564-3295© International Society for Tropical Ecology.
14. Sahu AK, Tandel BM, Patel NK. Effect of growing media on germination, growth and nutrients uptake of papaya seedlings (*Carica papaya* L.). The Pharma Innovation Journal. 2022;11(12):682-686.
15. Singh N, Singh V, Sarolia DK, Kaushik RA, Meena HR, Jat RK. Effect of pre-sowing seed treatments and media mixtures on germination and seedling vigour of custard apple seedlings. Bioved. 2019;30(1):67-72.
16. Choudhary RC, Krishi S, Pradesh VV, Pradesh J, Pradesh K, Gajendra S, *et al*. Effect of GA3 and growing media on seedling growth of papaya (*Carica papaya* L.) cv. Pusa Nanha. Scindia Krishi, Vishwa Vidyalaya, India. 2018.
17. Nair J, Juliya CS, Mathew. High density planting in papaya (*Carica papaya* L.). Department of Pomology and Floriculture, College of Agriculture, Vellayani. 2005.
18. Sondarva RL, Prajapati VM, Mehta ND, Bhusara J, Bhatt BK. Effect of various growing media on early seedling growth in *Khaya senegalensis* (Desr.) A. Juss. International Journal of Current Microbiology and Applied Sciences. 2017;6(12):3290-3294.
19. Bhagat S, Thakur A, Dhaliwal HS. Organic amendments influence growth, buddability and budding success in rough lemon (*Citrus jambhiri* Lush.). Biological Agriculture & Horticulture: An International Journal for Sustainable Production Systems. 2013;29(1):46-57.
20. Gawankar MS, Haldankar PM, Haldavanekar PC, Salvi BR, Jamadagni BM. Studies on seed germination and seedling growth in jackfruit (*Artocarpus heterophyllus* Lam.) as influenced by media. International Journal of Chemical Studies. 2019;7(5):1699-1705.
21. Kaur S. Effect of growing media mixtures on seed germination and seedling growth of different mango (*Mangifera indica* L.) cultivars under submountainous conditions of Punjab. Chem Science Review and Letters. 2017;6(23):1599-1603.
22. Choudhary J, Wilson D. To study the effect of different growing media on papaya (*Carica papaya*) seedling on germination percentage under protected condition cv. Pusa Nanha. International Journal of Current Microbiology and Applied Sciences. 2020;9(12):1035-1041.
23. Mishra U, Bahadur V, Prasad VM, Verty P, Singh AK, Mishra S, Swaroop N. Influence of GA3 and growing media on growth and seedling establishment of papaya (*Carica papaya* L.) cv. Pusa Nanha. International Journal of Current Microbiology and Applied Sciences. 2017;6(11):415-422