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Germination Response of Traditional tomato (*Solanum Lycopersicum*) Species to Organic Treatments in Polyhouse Conditions in Nagaland

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Abstract

This study investigates the germination percentages and optimal organic treatments for three traditional tomato species in Nagaland, India: Tomato (*Solanum lycopersicum* L. Syn. *Lycopersicon esculentum* Mill.), Cherry tomatoes (*Solanum pimpinellifolium*), and Tree tomato or Tamarillo (*Solanum betaceum* Cav.). Conducted from 2022 to 2023 in polyhouses at K-Station, Tseminyu, and Pfutseromi, Phek, the research reveals that cherry tomato seeds exhibited superior germination rates compared to tree tomato seeds. The selection of treatments significantly influenced germination percentages, with combinations such as garden wastes + FYM and coco peat + vermicompost + perlite showing promise. Variability in germination percentages across nursery stations underscores the influence of local environmental factors. This research offers valuable insights into optimizing tomato cultivation practices in Nagaland, highlighting the importance of treatment selection for enhancing germination rates in traditional tomato varieties. The study also underscores the agricultural challenges faced in Nagaland, such as limited knowledge of suitable cultivars and cultivation practices, and underscores the importance of understanding local agro-climatic conditions to address food security concerns.

Keywords: Agro-climatic conditions, germination percentage, Nagaland, solanaceae, tomato cultivation

Introduction

The Solanaceae, commonly known as the nightshade family, encompasses approximately 98 genera and 2700 species (Olmstead and Bohs, 2006) ^[14]. The term "tomato" likely originates from 'tomati', the word used by Mexican Indians to describe the plant they cultivated since ancient times. In the past, tomatoes were deemed poisonous in certain regions, likely due to their association with the nightshade family, which includes genuinely toxic plants.

Today, tomatoes are a vital vegetable crop cultivated worldwide, spanning tropical, subtropical, and temperate regions. They are grown both in greenhouses or protected structures and under natural conditions. Globally, tomatoes rank third in terms of cultivation area (>4 million ha) and production (>100 million tonnes), following potatoes and sweet potatoes, yet they top the list among processed vegetables. (Dhaliwal M.S., 2017) ^[15]. Tomatoes are consumed fresh in salads ^[13], cooked in various culinary dishes, and processed into numerous forms such as ketchup, sauce, puree, juice, soup, and chutney. This versatility underscores its significance in both global agriculture and culinary practices.

Solanaceae vegetables, notably the tomato (*Solanum lycopersicum* L. Syn. *Lycopersicon esculentum* Mill.), hold significant importance in our daily lives. The tomato ranks as the second most highly produced and consumed vegetable globally today (Devi and Nagar, 2017) ^[4]. The nutritional composition of tomato fruit is noteworthy, containing minerals (0.6 g) and vitamins, particularly vitamin A (321 IU) and vitamin C (31.0 mg), along with fiber (0.7 g), sulfur (24 mg), protein (1.98 g), moisture (93.1 g), calcium (20 mg), and chlorine (38 mg) per 100 g of fresh fruit weight (Waiba, and Sharma, 2020) ^[12]. In Nagaland, tomato cultivation is particularly valued, with a production of 19445.50 tons in a 2586.25ha area (Statistical Handbook of Nagaland, 2017) ^[16], reflecting its agricultural and economic significance in the region.

Cherry tomatoes (*Solanum pimpinellifolium*) are diminutive, round fruits belonging to the Solanaceae family. They are not only rich in vitamins but also serve as an excellent reservoir of antioxidant compounds, including polyphenols and carotenoids. These compounds play a pivotal role in averting various diseases such as cancer, cardiovascular ailments, and circulatory disorders induced by oxidative stress (Costa *et al.*, 2018)^[3]. The demand for cultivating and consuming cherry tomatoes has surged steadily over the years among both urban and rural populations due to their versatile applications, akin to other tomato varieties.

Tree tomato, also known scientifically as (*Solanum betaceum* Cav.), is a small tree or shrub bearing egg-shaped fruits. It goes by various names such as tomate de árbol, tomateandino in South America, and terong Belanda (Dutch eggplant) in Indonesia. Apart from South America, it is also popular and cultivated in regions like Kenya, South Africa, Nagaland, Manipur, Darjeeling, Sikkim in India, and several other South Asian countries. Tree tomato boasts a high pectin fiber content, a natural preservative used in the production of jellies, jams, and chutneys. Its pectin levels soar as high as 5 per cent, surpassing those found in apples (1.0-1.5 per cent), apricots (1.0 per cent), and other fruits (Vibha Varshney, 2020)^[19]. In Nagaland, it stands as one of the most esteemed exotic agricultural products, yielding 186.50 metric tons on a 93.00-hectare area (Statistical Handbook of Nagaland, 2017)^[16]. Moreover, the Naga tree tomato has been awarded the geographical indication tag in 2015, underscoring its unique regional identity (Reema Gowalla, 2022)^[22].

In Nagaland, Solanaceae vegetables, particularly various tomato varieties, feature prominently in almost every cuisine. This has resulted in a surge in demand within the state. Nagaland, situated in the northeastern region of India, boasts favourable topography and climatic conditions conducive to vegetable crop cultivation. However, despite its potential, only 40.850 000' hectares are utilized for cultivation, yielding a production of 453.65 000' metric tons, translating to a mere productivity of 1110.53 kg/ha (Statistical Handbook of Nagaland, 2017)^[16].

In contrast, on a national scale, the total cultivation area spans 10073 000' hectares, with a production of 183170 000' metric tons and a productivity of 18180 kg/ha (Agricultural statistic at a glance, 2020)^[1]. This glaring disparity underscores the challenge faced by farmers in Nagaland to meet the demand for crucial commercial vegetables like tomatoes. Several factors contribute to this shortfall, including:

- Lack of knowledge regarding cultivars best suited to the local agro-climatic conditions.
- Limited awareness of cultivation practices and inadequate availability of healthy saplings.
- Insufficient production quantity and absence of organized farming initiatives.

Materials and Methods

Site/Location selection

The experiment was conducted during 2022-2023 in two polyhouses situated at K Station, Tseminyu, Nagaland with 26.0022120 N latitude and 94.252470 E longitude at an elevation of 113.9 meters above the mean sea level and in Pfutseromi, Pfutsero, Phek with 25.5615140 N latitude and 94.2819970 E longitude at an elevation of 1772.4753 meters above the mean sea level, respectively.

Climatic condition

The experimental site is situated within the sub-tropical zone, characterized by Nagaland's state monsoonal (wet-dry) climate. The region experiences an annual rainfall ranging between 70 and 100 inches (1,800 and 2,500 mm), with precipitation concentrated during the southwest monsoon months from May to September.

Temperature variations correlate with elevation levels, where average summer temperatures fluctuate between the low 70s F (Approximately 21-23 °C) to the low 100s F (About 38-40 °C). During winter, temperatures seldom drop below 40 F (4 °C).

This climatic profile, as documented by NSDMA, GON (2022)^[23], for the agricultural practices and cultivation strategies employed in the region, impacting crop growth and productivity.

To assess seed germination in Petri dishes and portrays, we followed established protocols to ensure accurate and consistent results.

Experiment 1: Seed Germination Assessment in Petri Dishes

The procedure for assessing seed germination in Petri dishes involved the following steps, based on standard protocols:

Seed Selection and Hydration

1. Uniform and viable seeds were selected and hydrated in double-distilled water (ddH₂O) for 15 minutes to promote imbibition.
2. Sterilization:
3. Seeds were treated with a 0.1% sodium hypochlorite solution for 1 minute, followed by thorough rinsing in ddH₂O.
4. An additional sterilization step involved immersing seeds in 70% ethanol for 1 minute, followed by three successive washes in ddH₂O.
5. Placement in Petri Dishes:
6. Sterilized seeds were evenly distributed on moistened filter paper within Petri dishes, with approximately 10 ml of ddH₂O added to maintain optimal moisture.
7. Germination Conditions:
8. The Petri dishes were sealed and placed in a dark room to create an ideal environment for germination.

Experiment 2: Seed Germination Assessment in Portrays

For assessing germination efficiency in tomato species using portrays, the protocol included:

1. Seed Hydration

Dry seeds were soaked in distilled water for 12 hours for uniform water uptake.

2. Experimental Setup

A total of 150 seeds were used, divided into five treatment groups with 30 seeds each, planted in portrays filled with different media compositions.

Treatment Combination

- **Treatment 1:** Sand + soil mixture (1:1)
- **Treatment 2:** Garden wastes + FYM (1:1)
- **Treatment 3:** Treated Manure/FYM + cocopeat (0.25:1)
- **Treatment 4:** Coco Peat + Vermicompost + Perlite (6:3:1)
- **Treatment 5:** Soil + sand + FYM (1:1:1)

Result and Discussion

Experiment 1

Tomato Germination

At K-station, tomato seeds showed no germination in the first 3 days. Germination began at 4-6 days with 11.67%, then surged to 78.33% by 7-9 days. By 10-12 days, all seeds (100%) had germinated, and this was maintained through 13-15 days. In contrast, at Pfutseromi, the seeds had a slower start. By 4-6 days, 35% had germinated, and this increased to 43.33% by 7-9 days. The rate continued to rise to 63.33% by 10-12 days, reaching 83.33% by 13-15 days, but never achieving full germination within the observed period (Table 1).

The comparison between K-station and Pfutseromi highlights differences in environmental conditions affecting germination. K-station had a faster overall germination rate,

achieving full germination by 10-12 days, while Pfutseromi reached only 83.33% by 13-15 days. Factors such as temperature, soil composition, moisture levels, or light exposure likely contributed to these differences. The rapid germination at K-station suggests optimal conditions for seed growth, such as appropriate temperature and moisture levels, which are essential for enzyme activation, water uptake, and root growth. Pfutseromi slower rate indicates less favourable conditions. Despite initial differences, seeds at K-station achieved full germination, demonstrating resilience and adaptability. Similar results were reported by Dias *et al.* (2006) ^[6], where tomato seeds germinated within 2-7 days when incubated at 20/30°C in dark or shaded areas, emphasizing the influence of temperature and light on germination rates ^[9].

Table 1: Germination percentage of tomato seeds

Place	Total seeds	1-3 days (%)	4-6 days (%)	7-9 days (%)	10-12 days (%)	13-15 days (%)
K-station	20	0.00	11.67	78.33	100.00	100.00
Pfutseromi	20	0.00	35.00	43.33	63.33	83.33

Cherry Tomato Germination

The observed differences in germination rates between K-station and Pfutseromi for cherry tomato seeds align with findings from other studies on seed germination under varying environmental conditions. Similar findings were reported by Sousaraei *et al* (2022) ^[17] where tomato seeds subjected to optimal temperature and moisture conditions exhibited significantly faster germination rates compared to those in suboptimal environments. Similarly, Gerits *et al* (2024) ^[8] found that variations in soil composition and microclimate factors, such as humidity and light exposure, played critical roles in the germination success of *Solanum lycopersicum* varieties. Their study highlighted that seeds germinated more rapidly and uniformly in conditions where soil moisture levels were consistently maintained, and temperatures were within the optimal range for tomato seed germination. Further supporting these findings, Patricia *et*

al. (2022) ^[2] observed that seeds of cherry tomatoes exposed to higher levels of organic matter and well-drained soil conditions demonstrated accelerated germination rates and higher overall germination percentages. This suggests that soil quality and its ability to retain moisture without becoming waterlogged are crucial for the effective germination of tomato seeds ^[9].

The accelerated germination at K-station compared to Pfutseromi in your study reflects the importance of these factors. K-station likely provided a combination of optimal temperature, moisture, and possibly better soil composition or organic matter content, fostering a more conducive environment for seed germination.

Conversely, the slower germination at Pfutseromi indicates that its environmental conditions were less favourable, potentially due to lower soil quality, suboptimal moisture levels, or other microclimatic factors.

Table 2: Germination percentage of cherry tomato seeds

Place	Total seeds	1-3 days (%)	4-6 days (%)	7-9 days (%)	10-12 days (%)	13-15 days (%)
K-station	20	0.00	15.00	68.33	100.00	100.00
Pfutseromi	20	0.00	15.00	35.00	63.33	83.33

Tree Tomato Germination

For tree tomato seeds, K-station showed no germination by 22 days and only 2.50% by 26 days. The rate then gradually increased, reaching 85.00% by 36 days. Pfutseromi, however, had 10.00% germination by 22 days and 20.00% by 24 days. The rate then plateaued at 22.50% until 30 days, before increasing to 52.50% by 32 days, 70.00% by 34 days, and 85.00% by 36 days (Table 3).

Pfutseromi showed an earlier onset of germination but a slower progression compared to K-station. This suggests that while initial conditions at Pfutseromi favoured the start of germination, they were not sustained for continued

growth. K-station, despite a delayed start, provided consistent conditions leading to a steady increase in germination.

These results highlight the importance of understanding and optimizing local environmental conditions for seed germination. Tailoring agricultural practices to local conditions can improve germination rates and overall crop yield. Similar findings were reported by Torres-González (2019) ^[18], where tree tomato seeds germinated 70-85% when moistened with water and kept in a petri dish with filter papers, emphasizing the role of moisture in seed germination.

Table 3: Germination percentage of tree tomato seeds

Place	Total seeds	22 days (%)	24 days (%)	26 days (%)	28 days (%)	30 days (%)	32 days (%)	34 days (%)	36 days (%)
K-station	20	0.00	0.00	2.50	10.00	20.00	40.00	65.00	85.00
Pfutseromi	20	10.00	20.00	22.50	22.50	22.50	52.50	70.00	85.00

Experiment 2

Seed trays were prepared according to the treatment combinations, and 150 seeds of each species were planted. Seedlings raised in plug trays germinate earlier and are more vigorous compared to those in traditional nursery beds. These seedlings exhibit robust root development and lower mortality rates. Plug trays are commonly used for growing most vegetables and all types of flowers. The plugs, filled with a cohesive medium, are eventually transplanted into other growing systems. Seeds are manually sown into each cell of the plug trays, with one plant raised per cell. The adoption of plug tray-grown transplants has expanded to ensure a consistent supply of high-quality seedlings and to enhance transplanting efficiency (Jeong, 1992) ^[11].

Effect of Different Treatments on the Germination Percentage for Cherry Tomato

Table 4 details the impact of various treatments on the germination percentage of Cherry Tomato seeds at two nursery stations, K station and Pfulseromi. The treatments include combinations of sand + soil, garden wastes + FYM (Farmyard Manure), treated manure/FYM + cocopeat, cocopeat + vermicompost + perlite, and soil + sand + FYM.

The results show distinct differences in germination percentages across treatments and nursery stations. At 7 days after sowing (DAS), germination was 0.00% at K station and 18.40% at Pfulseromi, with Pfulseromi generally showing higher germination rates over time. This aligns with findings from Liaquat *et al.* (2020) ^[12], who reported germination occurring between 5-14 days for most cherry tomato varieties.

Analysis of treatment effects reveals significant variations. For instance, at 11 DAS, germination percentages ranged from 70.60% (T₂: Garden wastes + FYM) to 94.40% (T₄: Cocopeat + Vermicompost + Perlite), indicating that some treatments are more effective than others. This is consistent with studies by Jeevitha *et al.* (2019) ^[10] and Eswaran and Mariselvi (2016) ^[7], who found high germination rates using FYM and vermicompost.

The interaction between nursery stations and treatments shows that treatment performance can vary by location. For example, at 9 DAS, T₁ (Sand + soil mixture) had a germination percentage of 20.60% at both stations, showing consistent performance across locations. Conversely, T₂ (Garden wastes + FYM) varied between stations, with 43.30% at K station and 66.00% at Pfulseromi.

Table 4: Effect of different treatments on the germination percentage for Cherry Tomato across nursery stations

Treatments	7DAS	9DAS	11DAS	13DAS	15DAS
T ₁ Sand + soil mixture	0.00	20.60	88.30	96.70	100.00
T ₂ Garden wastes + FYM	83.00	43.30	70.60	83.90	100.00
T ₃ Treated Manure/FYM + cocopeat	83.00	33.90	89.40	93.90	100.00
T ₄ Coco Peat + Vermicompost + Perlite	24.40	42.20	94.40	91.70	100.00
T ₅ Soil + sand + FYM	50.00	45.60	81.70	95.60	100.00
SEM±	0.62	1.16	0.61	0.31	0.59
CD at 5%	1.86 (NS)	3.50 (NS)	1.83 (NS)	1.78 (NS)	0.94
Nursery stations					
K station N ₁	0.00	8.20	82.70	91.00	92.00
Pfulseromi N ₂	18.40	66.00	87.10	93.60	97.70
SEM±	0.48	0.90	0.47	0.46	0.24
CD at 5%	1.44	2.71	1.42 (NS)	1.38(NS)	0.73
Interaction (N X P)					
N ₁ T ₁	0.00	20.60	100.00	100.00	96.70
N ₁ T ₂	0.00	43.30	51.11	64.40	74.40
N ₁ T ₃	0.00	33.90	80.00	86.70	87.80
N ₁ T ₄	0.00	42.20	100.00	100.00	96.70
N ₁ T ₅	0.00	45.60	77.80	100.00	100.00
N ₂ T ₁	0.00	20.60	88.30	100.00	96.70
N ₂ T ₂	16.70	43.30	70.60	96.70	93.30
N ₂ T ₃	16.70	33.90	89.40	100.00	100.00
N ₂ T ₄	48.90	42.20	94.40	93.30	86.70
N ₂ T ₅	10.00	45.60	81.70	91.10	91.10
SEM±	1.07	2.01	1.05	1.03	0.54
CD at 5%	3.23 (NS)	6.07 (NS)	3.17 (NS)	3.09(NS)	1.64

Effect of Different Treatments on the Germination Percentage of Tomato

This study investigated the impact of various treatments on the germination percentage of Tomato seeds at two nursery stations, K station and Pfulseromi, over several days after sowing (DAS). The treatments included sand + soil mixture (T₁), garden wastes + farmyard manure (FYM) (T₂), treated manure/FYM + cocopeat (T₃), coco peat + vermicompost + perlite (T₄), and soil + sand + FYM (T₅).

The results indicate variability in germination percentages among treatments and between nursery stations. For

instance, at 13 DAS, the highest germination rate was observed in T₅ (Soil + sand + FYM), recording 91.7% at both K station and Pfulseromi. Conversely, the lowest was seen in T₃ (Treated Manure/FYM + cocopeat), with 84.4% at K station and 79.4% at Pfulseromi. These observations align with those of Vivek and Duraisamy (2017) ^[20], who reported germination rates of 80-90% with coco peat and vermicompost and 90-99% with soil, sand, and FYM.

When comparing nursery stations, K station consistently exhibited higher germination percentages than Pfulseromi. For example, at 9 DAS, percentages at K station ranged

from 27.8% to 35.6%, while Pfutseromi displayed a broader range from 30% to 56%.

Moreover, the interaction between nursery stations and treatments suggests station-specific responses to the treatments. At K station, T₁ (Sand + soil mixture) and T₅

(Soil + sand + FYM) demonstrated the highest germination percentages. At Pfutseromi, however, T₂ (Garden wastes + FYM) and T₄ (Coco Peat + Vermicompost + Perlite) were more effective.

Table 5: Effect of different treatments on the germination percentage for Tomato across nursery stations

Treatments	7DAS	9DAS	11DAS	13DAS	15DAS
T ₁ Sand + soil mixture	-	27.80	65.60	84.40	85.60
T ₂ Garden wastes + FYM	-	35.60	66.70	80.00	82.20
T ₃ Treated Manure/FYM + cocopeat	-	18.30	73.30	84.40	86.10
T ₄ Coco Peat + Vermicompost + Perlite	-	27.20	79.40	89.60	90.00
T ₅ Soil + sand + FYM	-	35.60	80.60	91.70	91.70
SEM±	-	0.73	0.75	0.42	0.37
CD at 5%	-	2.21 (NS)	2.26 (NS)	1.25 (NS)	1.13 (NS)
Nursery stations					
K station N ₁	-	27.80	90.20	92.70	92.70
Pfutseromi N ₂	-	30.00	56.00	79.40	80.70
SEM±	-	0.57	0.58	0.32	0.29
CD at 5%	-	1.71 (NS)	1.75	0.97	0.87
Interaction (N X P)					
N ₁ T ₁	-	48.90	100.00	100.00	100.00
N ₁ T ₂	-	11.10	65.60	75.60	80.00
N ₁ T ₃	-	8.90	88.90	91.10	91.10
N ₁ T ₄	-	20.00	96.70	96.70	96.70
N ₁ T ₅	-	50.00	100.00	100.00	100.00
N ₂ T ₁	-	6.70	31.10	68.90	71.10
N ₂ T ₂	-	60.00	67.80	84.40	84.40
N ₂ T ₃	-	27.80	57.80	77.80	81.10
N ₂ T ₄	-	34.40	62.20	82.60	83.30
N ₂ T ₅	-	21.10	61.10	83.30	83.30
SEM±	-	1.27	1.30	0.72	0.65
CD at 5%	-	3.83 (NS)	3.91 (NS)	2.17 (NS)	1.95 (NS)

Effect of Different Treatments on the Germination Percentage of Tree Tomato

This study evaluated the impact of various treatments on the germination percentage of Tree Tomato seeds at two nursery stations, K station and Pfutseromi, over intervals from 20 to 32 days after sowing (DAS). The treatments included sand + soil mixture (T₁), garden wastes + farmyard manure (FYM) (T₂), treated manure/FYM + cocopeat (T₃), coco peat + vermicompost + perlite (T₄), and soil + sand + FYM (T₅). The results are presented in terms of germination percentage, standard error of the mean (SEM), and critical difference (CD) at a 5% significance level.

A comparison between the two nursery stations indicates that Pfutseromi generally exhibits higher germination percentages than K station across most treatment intervals. For example, at 20 DAS, Pfutseromi showed a germination percentage of 34.00%, significantly higher than K station's 9.60%. This pattern persisted through to 32 DAS, where Pfutseromi recorded 58.70% compared to 56.00% at K station.

In terms of treatment effectiveness, T₂ (garden wastes + FYM) consistently demonstrated the highest germination percentages across both stations and throughout the study period, followed by T₄ (Coco peat + vermicompost + perlite), which performed particularly well at later stages.

The interaction analysis between nursery stations and treatments revealed significant variances in germination performance. The combination of N₁T₂ consistently resulted in higher germination rates compared to other treatment-station combinations.

In conclusion, the data indicate that treatment choice substantially influences the germination success of Tree Tomato seeds, with garden wastes + FYM and coco peat + vermicompost + perlite proving to be particularly effective. Additionally, the nursery station plays a critical role, with Pfutseromi typically achieving higher germination rates than K station. Further detailed statistical analysis and additional replicates would be beneficial to confirm these trends.

Table 6: Effect of different treatments on the germination percentage for Tree Tomato across nursery stations

Treatments	20DAS	22DAS	24DAS	26DAS	28DAS	30DAS	32DAS
T ₁ Sand + soil mixture	5.00	11.70	20.00	25.00	26.70	31.70	31.70
T ₂ Garden wastes + FYM	35.00	50.00	65.40	80.00	80.00	80.00	85.00
T ₃ Treated Manure/FYM + cocopeat	24.00	40.00	50.00	50.00	50.00	50.00	50.00
T ₄ Coco Peat + Vermicompost + Perlite	24.40	35.40	55.10	60.00	60.00	60.00	60.00
T ₅ Soil + sand + FYM	20.00	30.70	55.40	60.00	65.00	65.00	65.00
SEM $\pm$	0.50	0.67	0.34	0.22	0.19	0.18	0.17
CD at 5%	1.49	2.01	1.02	0.67	0.58	0.56	0.51
Nursery stations							
K station N ₁	9.60	18.80	42.00	50.00	54.00	56.00	56.00
Pfuteromi N ₂	34.00	48.30	56.40	60.00	58.70	60.70	58.70
SEM $\pm$	0.38	0.52	0.26	0.17	0.15	0.14	0.13
CD at 5%	1.16	1.55	0.79	0.52	0.45 (NS)	0.43 (NS)	0.39 (NS)
Interaction (N X P)							
N ₁ T ₁	0.00	3.30	10.00	20.00	20.00	30.00	30.00
N ₁ T ₂	10.00	20.00	50.00	70.00	80.00	80.00	80.00
N ₁ T ₃	18.90	40.00	50.00	50.00	50.00	50.00	50.00
N ₁ T ₄	8.90	10.00	50.00	50.00	50.00	50.00	50.00
N ₁ T ₅	10.00	20.70	50.00	60.00	70.00	70.00	70.00
N ₂ T ₁	10.00	20.00	30.00	30.00	33.30	33.30	33.30
N ₂ T ₂	60.00	80.00	80.80	90.00	80.00	90.00	80.00
N ₂ T ₃	30.00	40.00	50.00	50.00	50.00	50.00	50.00
N ₂ T ₄	40.00	60.70	60.10	70.00	70.00	70.00	70.00
N ₂ T ₅	30.00	40.80	60.90	60.00	60.00	60.00	60.00
SEM $\pm$	0.86	1.15	0.59	0.39	0.34	0.32	0.29
CD at 5%	2.59 (NS)	3.48 (NS)	1.77 (NS)	1.17 (NS)	1.01	0.96	0.88

Conclusions

The experiments conducted at K-Station and Pfuteromi in Nagaland demonstrated that optimizing local environmental conditions and selecting appropriate organic treatments significantly enhance the germination rates of various tomato species. K-Station consistently provided more favourable conditions, achieving higher germination percentages across all species compared to Pfuteromi. The use of coco peat, vermicompost, and perlite proved particularly effective for cherry tomatoes, facilitating rapid germination. For tomatoes, a mixture of soil, sand, and FYM yielded the highest germination rates. These findings emphasize the critical role of tailored organic treatments in improving seed germination efficiency, with specific combinations yielding optimal results for different tomato species.

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