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Yashshree Balasaheb Lawate
 M. Sc. Scholar, Department of
 Vegetable Science, College of
 Horticulture, Dapoli, Dr. Balasaheb
 Sawant Konkan Krishi Vidyapeeth,
 Dapoli, Maharashtra, India

YR Parulekar
 Vegetable Specialist, Vegetable
 Improvement Scheme, Central
 Experimental Station, Wakawali,
 Tal-Dapoli, Dist- Ratnagiri,
 Maharashtra, India

YS Saitwal
 Assistant Professor, Department of
 Vegetable Science College of
 Horticulture, Dapoli Dr. Balasaheb
 Sawant Konkan Krishi Vidyapeeth,
 Dapoli, Maharashtra, India

PC Mali
 Professor (CAS) and Head
 Department of Fruit Science
 College of Horticulture, Dapoli Dr.
 Balasaheb Sawant Konkan Krishi
 Vidyapeeth, Dapoli, Maharashtra,
 India

VG More
 Former Deputy Director of
 Research (Agri.), Department of
 Agriculture, Dr. Balasaheb Sawant
 Konkan Krishi Vidyapeeth, Dapoli,
 Maharashtra, India

SB Patil
 M. Sc. Scholar, Department of
 Vegetable Science, College of
 Horticulture, Dapoli, Dr. Balasaheb
 Sawant Konkan Krishi Vidyapeeth,
 Dapoli, Maharashtra, India

Corresponding Author:
**Yashshree Balasaheb
 Lawate**

M. Sc. Scholar, Department
 of Vegetable Science,
 College of Horticulture,
 Dapoli, Dr. Balasaheb
 Sawant Konkan Krishi
 Vidyapeeth, Dapoli,
 Maharashtra, India

Title of Research Paper - “Performance of *Basella* (*Basella alba* L.) under different growing conditions and various trelling systems”

Yashshree Balasaheb Lawate¹, YR Parulekar², YS Saitwal³, PC Mali⁴, VG More⁵, SB Patil⁶

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ABSTRACT

The investigation entitled “Performance of *Basella* (*Basella alba* L.) under different growing conditions and various trelling systems” was conducted at the College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Maharashtra, during the academic year 2025-26. The study was laid out in a factorial randomized block design comprising two factors, nine treatment combinations and three replications. The experiment involved two factors - Factor A: Growing conditions (G_1 : Coconut Garden, G_2 : 50% Shade net, G_3 : Open field) and Factor B: Trelling systems (T_1 : Small bowers, T_2 : Vertical trelling, T_3 : Multi-storeyed trays). The findings of the study indicated that different growing conditions and trelling systems had a significance influence on the growth and growth attributes. Among different growing conditions, G_1 (coconut garden) recorded the highest shoot length (201.30 cm), stem girth (13.45 mm), average leaf size (30.69 cm²), number of leaves (93.86). In case of trelling systems, T_1 (small bowers) recorded the highest average leaf size (30.39 cm²) and number of leaves (84.11). The interaction effect, G_1T_1 (small bower of plants in coconut garden) recorded the highest stem girth (13.77 mm), average leaf size (36.98 cm²) and number of leaves (101.02). Thus, from the results obtained, small bower of plants in coconut garden was found to be superior in Konkan region.

Keywords: Indian spinach, Growing conditions, Trelling systems, Growth attributes

1. Introduction

Indian spinach belongs to the family Basellaceae and is widely known by several common names, including Chinese spinach, vine spinach, climbing spinach, Malabar spinach, Ceylon spinach, and Indian spinach (Deshmukh *et al.*, 2014) [1]. In traditional Indian systems of medicine, it is also referred to by various regional and Ayurvedic names such as Upodika, Potaki, Malvaa, and Amritvallari. In Siddha medicine and Tamil usage, it is commonly called Vaslakkirai (Khare, 2004) [2].

Basella rubra and *Basella alba* were identified as two distinct species of Indian spinach based on their chromosomal differences and morphological characteristics. *Basella rubra* has a chromosome number of $2n = 44$, whereas *Basella alba* has $2n = 48$. These two species can be distinguished primarily by the colour of their stems and leaves. *Basella rubra* possesses reddish stems, while *Basella alba* has thicker green stems and green foliage.

Basella is a perennial climbing vine characterized by fibrous roots. Its stem is soft, fleshy, slender, smooth, and glossy, while the leaves are arranged spirally along the stem. The plant also produces side branches and, when not pruned, can grow up to approximately 8–10 m in length. The petiole is short, and the leaves are oblong in shape. Flowers of *Basella alba* may appear white, red, or pink depending on the variety. The fruits are usually dark red or black in colour. Its seeds possess a shiny, rough outer surface and are black or brown, enclosed within a thick seed coat. Under favourable storage and environmental conditions, the seeds may remain viable for as long as four years (Almeida, 2003; Mahr, 2014) [3, 4].

Basella alba is widely cultivated in countries and regions including Malaysia, the Philippines, tropical Africa, the Caribbean, tropical South America, and southeastern Brazil (ECHO, 2006) [5]. Owing to its adaptability to different soil conditions and climates, *Basella* is regarded as one of the most valuable tropical leafy vegetables grown around the world (Palada *et al.*, 1999) [6].

2. Material and Methods

The present investigation entitled, “Performance of *Basella* (*Basella alba* L.) under different growing conditions and various trelling systems” was undertaken with the aim of developing an improved production technique for *Basella* under the agro-climatic conditions of the Konkan region, at the College of Horticulture,

Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, during the year 2025-2026. The study was laid out in a factorial randomized block design comprising two factors, nine treatment combinations and three replications. The experiment involved two factors - Factor A: Growing conditions (G_1 : Coconut Garden, G_2 : 50% Shade net, G_3 : Open field) and Factor B: Trelling systems (T_1 : Small bowers, T_2 : Vertical trelling, T_3 : Multi-storeyed trays). The total experimental area was 119.34 m². For each treatment, the raised bed of size 2.7 m × 1.2 m was prepared under a FRBD design comprising 9 treatment combinations with three replications. The research work was conducted from December 2025 to May 2026. To record biometric observations, 5 plants were randomly chosen from each net plot. The selected plants were labelled properly. The data obtained from the experiment were subjected to statistical analysis using the analysis of variance (ANOVA) appropriate for Factorial Randomized Block Design. The significance of differences among the treatment means was tested according to the procedure described by Panse and Sukhatme (1985).

3. Results and Discussion

3.1 Effect of growing conditions (G)

The different growing conditions had significant effect on shoot length (cm), stem girth (mm), average leaf size (cm²), number of leaves and number of branches as shown in Table 1.

The highest shoot length was observed under the G_1 treatment (201.30 cm), while the lowest shoot length was recorded in G_3 (126.50 cm). The significant variation in shoot length among various growing conditions may be due to differences in microclimate, soil moisture and nutrient availability. The similar results were also reported by Deogirikar *et al.* (2005) [7] in isabgol, Rajasekar *et al.* (2013) [8] in amaranths, Mahajan *et al.* (2017) [9] in coriander, Habib *et al.* (2020) [10] in Indian spinach, Akter *et al.* (2022) in Indian spinach.

Treatment combination	Treatment details
G_1T_1	small bower of plants in coconut garden
G_1T_2	vertical trelling of plants in coconut garden
G_1T_3	multi-storeyed trays of plants in coconut garden
G_2T_1	small bower of plants in 50% shade net
G_2T_2	vertical trelling of plants in 50% shade net
G_2T_3	multi-storeyed trays of plants in 50% shade net
G_3T_1	small bower of plants in open field
G_3T_2	vertical trelling of plants in open field
G_3T_3	multi-storeyed trays of plants in open field

The highest stem girth (13.45 mm), was reported in G_1 , whereas, lowest stem girth was observed in G_3 (10.60 mm). Overall, the results indicated that the maximum stem girth was observed in G_1 , as the coconut garden condition at various growth stages might be due to availability of favourable environment with moderate light intensity, reduced temperature, higher relative humidity, and better soil moisture conservation. The similar results were also reported by Chávez-Servín *et al.* (2017) [11] in amaranths, Pawar (2019) [12] in amaranths, Khan *et al.* (2024) [13] in Indian spinach, Osinaike *et al.* (2024) [14] in Indian spinach.

The highest average leaf size (30.69 cm²) was registered in G_1 , while G_3 recorded the lowest (21.97 cm²) average leaf size. The significant variation in average leaf size may be attributed to differences in light

availability, temperature, humidity and moisture conditions under the different growing environments. Similar findings were recorded by Kotadia *et al.* (2012) [15] in spinach, Akter *et al.* (2022) in Indian spinach, Osinaike *et al.* (2024) [14] in Indian spinach.

The maximum number of leaves (93.86) were reported in G_1 , while the lowest was observed in G_2 (63.29). The superior leaf production under coconut garden, may be attributed to favourable light intensity, temperature and moisture availability in coconut garden, which enhanced photosynthetic activity and vegetative growth. Similar observations had been reported by Dixit (2007) [16] in spinach, Kotadia *et al.* (2012) [15] in spinach, Rajasekar *et al.* (2013) [8] in amaranths, Isaac (2015) [17] in coriander, Gowtham *et al.* (2018) [18] in coriander, Akter *et al.* (2022) in Indian spinach, Managa *et al.* (2023) [19] in amaranths, Osinaike *et al.* (2024) [14] in Indian spinach.

The maximum number of branches were observed under the G_3 treatment (4.49) which was at par with G_1 (3.98), whereas, the minimum number of branches were recorded in G_2 (3.16). The higher number of branches under open-field conditions may be attributed to greater exposure to natural sunlight, better air circulation, and adequate space for lateral shoot development. The similar results were also reported by Akter *et al.* (2022) in Indian spinach.

3.2 Effect of trelling systems (T)

The different trelling systems had a significant effect on shoot length (cm), stem girth (mm), average leaf size (cm²), number of leaves and number of branches as shown in Table 2.

The longest shoot length (181.54 cm) was recorded in T_2 which was at par with T_1 (177.81 cm), while the shortest shoot length (111.94 cm) was reported in T_3 . The highest shoot length recorded under vertical trelling (T_2), may be attributed to the availability of adequate vertical growing space and continuous support for the climbing habit of *Basella*. The similar results were also reported in ridge gourd (*Luffa acutangula* L. Roxb) by Hilli *et al.* (2009) [20], in bottle gourd (*Lagenaria siceraria*) by Kalyanrao *et al.* (2012) [21] and in bitter melon by Singh *et al.* (2014) [22], Ahmed *et al.* (2021) [23] in ridge gourd (*Luffa acutangula* L. Roxb), Agnihotri *et al.* (2025) [24] in Indian spinach.

The highest stem girth (12.36 mm) was observed in T_2 , whereas, T_1 recorded the lowest stem girth (11.07 mm). The maximum stem girth under (T_2) - vertical trelling, might be due to better canopy organization, improved sunlight exposure and air circulation, which enhanced the photosynthesis and assimilate production. These assimilates are efficiently utilized for stem growth thickening.

The highest average leaf size (30.39 cm²) was reported in T_1 , while the lowest average leaf size (25.66 cm²) was recorded in T_3 . The larger leaf size under T_1 - small bowers, may be attributed to better exposure to light, improved air circulation, and greater availability of space for leaf expansion. Similar findings were recorded in Hamayoun *et al.* (2018) [25] in cucumber (*Cucumis sativus* L.).

The highest number of leaves (84.11) were registered in T_1 , whereas the lowest was observed in T_3 (65.89). The higher number of leaves in T_1 - small bowers, can be attributed to better support and wider canopy spread due to the available space and support which promoted efficient light penetration, enhanced photosynthesis and vegetative growth, resulting in greater leaf production. Similar findings were observed in ridge gourd (*Luffa acutangula* L. Roxb) by Hilli *et al.* (2009) [20], in cucumber by Hamayoun *et al.* (2018) [25] and in Indian spinach by Agnihotri *et al.* (2025) [24].

The highest number of branches (4.71) were recorded in T_2 , while the lowest were reported in T_3 (2.58). The higher number of branches under vertical trellising (T_2), may be due to better support and vertical distribution of shoots, which might have improved light interception and encourages lateral branching. Similar findings were recorded by Hilli *et al.* (2009) [20] in ridge gourd (*Luffa acutangula* L. Roxb), Singh *et al.* (2014) [22] in bitter melon, Kapuriya *et al.* (2017) [26] in cucumber, Agnihotri *et al.* (2025) [24] in Indian spinach.

3.3 Interaction effect (GXT)

The different growing conditions and trelling systems had a significant effect on shoot length (cm), stem girth (mm), average leaf size (cm²), number of leaves and number of branches as shown in Table 3. Among the treatment combinations, G₁T₂ registered the highest shoot length (251.43 cm), while the lowest shoot length (99.47 cm) was reported in G₂T₃. Vertical support allowed better and unrestricted shoot elongation, better exposure to sunlight increased photosynthesis and vegetative growth, efficient use of available space, moisture and nutrients promoted vigorous growth, improved air circulation and reduced shading favoured healthy shoots.

The highest stem girth (13.77 mm) was recorded in G₁T₁ which was at par with G₁T₂ (13.76 mm) and G₂T₂ (13.47 mm), whereas the lowest stem girth (9.85 mm) was reported in G₃T₂. As the effect of trelling system and growing conditions was significant. It is obvious that their interaction found was also significant. The maximum stem girth in G₁T₂ - coconut garden with vertical trelling, may be due to better light availability, favourable microclimate, improved canopy organization, efficient utilization of water and nutrient availability which enhanced photosynthesis and assimilate accumulation for stem development.

The highest average leaf size (36.98 cm²) was registered in G₁T₁ which was at par with G₂T₁ (33.13 cm²), while G₃T₂ recorded the lowest average leaf size (19.56 cm²). The higher leaf size in G₁T₁ - small bowers of plants in coconut garden, may be attributed to better light interception, improved air circulation, and reduced competition among plants, which promoted photosynthetic activity and leaf expansion.

Among the treatment combinations, the highest number of leaves (101.02) was recorded in G₁T₁ which was at par with G₁T₂ (92.15), G₁T₃ (88.41), G₂T₁ (86.02) and G₃T₂ (84.44), while the lowest number of leaves (47.51) was reported in G₂T₃. The higher number of leaves in G₁T₁ - small bower in coconut garden, may be due to better light availability, favourable microclimate and greater growing space in coconut orchard which enhanced vegetative growth and availability of sunlight affected photosynthesis.

The highest number of branches (6.40) was recorded in G₃T₂, whereas G₁T₃ recorded the lowest number of branches (2.53). The highest number of branches in G₃T₂ - vertical trelling of plants in the open field, may be attributed to the combined advantage of sunlight exposure, extensive growing space availability, improved aeration, and effective vertical support, which promoted vigorous lateral shoot development.

Table 1. Effect of growing conditions on growth parameters of Indian spinach

Growing conditions	Shoot length (cm)	Stem girth (mm)	Average leaf size (cm ²)	Number of leaves	Number of branches
G ₁	201.30	13.45	30.69	93.86	3.98
G ₂	143.48	12.21	29.48	63.29	3.16
G ₃	126.50	10.60	21.97	70.49	4.49
Result	SIG	SIG	SIG	SIG	SIG
S.Em. (±)	6.54	0.09	1.00	3.67	0.24
CD at 5%	19.59	0.28	3.00	10.99	0.71

Table 2. Effect of trelling systems on growth parameters of Indian spinach

Trelling systems	Shoot length (cm)	Stem girth (mm)	Average leaf size (cm ²)	Number of leaves	Number of branches
T ₁	177.81	11.99	30.39	84.11	4.33
T ₂	181.54	12.36	26.08	77.65	4.71
T ₃	111.94	11.92	25.66	65.89	2.58
Result	SIG	SIG	SIG	SIG	SIG
S.Em. (±)	6.54	0.09	1.00	3.67	0.24
CD at 5%	19.59	0.28	3.00	10.99	0.71

Table 3. Interaction effect of growing conditions and trelling systems on growth parameters of Indian spinach

Interaction effect	Shoot length (cm)	Stem girth (mm)	Average leaf size (cm ²)	Number of leaves	Number of branches
G ₁ T ₁	216.42	13.77	36.98	101.02	4.80
G ₁ T ₂	251.43	13.76	31.66	92.15	4.60
G ₁ T ₃	136.03	12.83	23.44	88.41	2.53
G ₂ T ₁	188.84	10.56	33.13	86.02	3.73
G ₂ T ₂	142.15	13.47	27.02	56.35	3.13
G ₂ T ₃	99.47	12.62	28.29	47.51	2.60
G ₃ T ₁	128.17	11.64	21.08	65.28	4.47
G ₃ T ₂	151.03	9.85	19.56	84.44	6.40
G ₃ T ₃	100.31	10.30	25.56	61.76	2.60
Result	SIG	SIG	SIG	SIG	SIG
S.Em. (±)	11.32	0.16	1.74	6.35	0.41
CD at 5%	33.93	0.49	5.20	19.03	1.23

Conclusion

Based on the present investigation, it can be concluded that the growing conditions and trelling systems influenced the growth parameters of Indian spinach (*Basella alba* L.). Among the different growing conditions, G₁ - coconut garden was found to be superior in terms of growth. Among various trelling systems, T₁ - small bower was superior. Hence, the treatment combination of small bower of plants in coconut garden (G₁T₁) found to be beneficial for Konkan agro-climatic conditions.

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