# Variation in Morphological Characteristics of *Boerhavia diffusa* L. from different Locations of Kanyakumari district

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**ABSTRACT**

*This study explores the morphological variations of Boerhavia diffusa L., a tomentose herb with trailing branches and a reddish stem, across five distinct locations in the Kanyakumari district. Ten plants per location were analysed for mature leaf length, width, number of leaves, stem characteristics, root attributes, inflorescence length, and flower count. Statistical analysis revealed significant differences ($p < 0.05$) among these characteristics across locations. The blossoms, characterized by their small size and pink coloration, exhibited consistent traits in line with previous research. Notable variations were observed in root and stem dimensions, inflorescence length, and the number of flowers. The collection data, including location coordinates and date of collection, were meticulously recorded. This comprehensive study provides valuable insights into the diverse morphological features of Boerhavia diffusa in different agroclimatic zones, contributing to a better understanding of its genetic diversity and environmental adaptability.*

***Keywords:*** *Boerhavia diffusa L., Kanyakumari district, Morphological variation*

## Introduction

Plant morphology encompasses the examination of both the vegetative and reproductive components of a plant. This includes the shoot system and root system, comprising stems, leaves, and roots, as well as reproductive structures such as inflorescence and flowers in vascular plants.

Throughout history, medicinal herbs have played a crucial role in alleviating various chronic conditions. Researchers have been intrigued by biologically active compounds derived from natural sources, as evidenced by studies such as [23]. The evolving fields of medicinal plant genome evolution mechanisms, systematics, and the interplay between plant genomes and the environment have further deepened our understanding of plant genotypes and metabolic phenotypes.

Tribal communities, relying on traditional knowledge systems, have historically utilized medicinal plants for treating various ailments. These communities, guided by trial-and-error methods over centuries, attest to the life-saving properties of medicinal plants since the dawn of human civilization. Even today, tribal societies heavily depend on plants for medical needs, preserving a wealth of traditional knowledge through generations [22].

*Boerhavia diffusa* L., commonly known as 'Punarnava' in Indian medicine, is a perennial creeping plant found in wastelands across India. Its roots are renowned for treating conditions such as anasarca, ascites, and jaundice, exhibiting diuretic and laxative properties [24]. With a rich history of therapeutic usage in Ayurveda and Unani medical systems, various plant components, including roots, seeds, and simple juice, are employed to address a range of health issues [1, 7, 8,12, 14, 19, 20, 21, 26].

*Boerhavia diffusa* is rich in proteins and lipids, with the herb containing 15 amino acids, including six essential ones. The root, on the other hand, possesses 14 amino acids, including seven essential ones. Additionally, the plant contains potassium nitrate, apart from punarnavine [6].

Considering the ecological context, plant species thrive in diverse conditions, facing ecological factors that influence their growth along environmental gradients. Microhabitats within the same habitat can exhibit significant environmental variability, impacting species persistence and population demography. Ecologists aim to understand the strategies employed by plant species to overcome ecological challenges, especially in response to changes in microtopography due to varying edaphic and climatic conditions [9,15].

Research on species reactions to habitats, particularly in dry and semi-arid environments, where water plays a crucial role, is essential. Changes in soil properties, as observed in the Mediterranean area, may prompt plants to adapt locally.

In this study, variations in mature leaf length, mature leaf width, number of leaves per plant, stem length, stem width, number of branches, root length, root width, inflorescence length, and number of flowers in *Boerhavia diffusa* plants collected from five different locations are examined and documented.

**Materials and Methods**

The plant is characterized as a tomentose herb featuring lengthy trailing branches and a reddish stem. The petiole measures up to 1 cm in length, and the leaves are unequal, oval, obtuse, and exhibit undulations along the edges. They are also truncate to subcordate at the base, displaying a tomentose texture. The plant has five bracts that are oblong and glandular, with pink perianth, three stamens, and a clavate capsule measuring 3 x 1 mm, characterized by

five ribs and a glandular nature. The flowers, measuring 4 mm in length, are clustered in groups of 4-10, arranged in axillary or terminal, peduncled umbels.

For the morphological investigations, a total of five accessions, representing genetically diverse genotypes of *Boerhavia diffusa*, were collected from various agroclimatic zones within the Kanyakumari district. Morphological data, including mature leaf length, mature leaf width, number of leaves per plant, stem length, stem width, number of branches, root length, root width, inflorescence length, and number of flowers, were recorded for all ten plants. The data were tabulated, and averages were computed using Excel for comprehensive analysis.

**Results and Discussion**

Statistical analysis of mature leaf length, mature leaf width, number of leaves per plant, stem length, stem width, number of branches, root length, root width, inflorescence length, and number of flowers revealed a significant difference ($p < 0.05$) among the plant characteristics studied across five distinct locations. (Table 1).

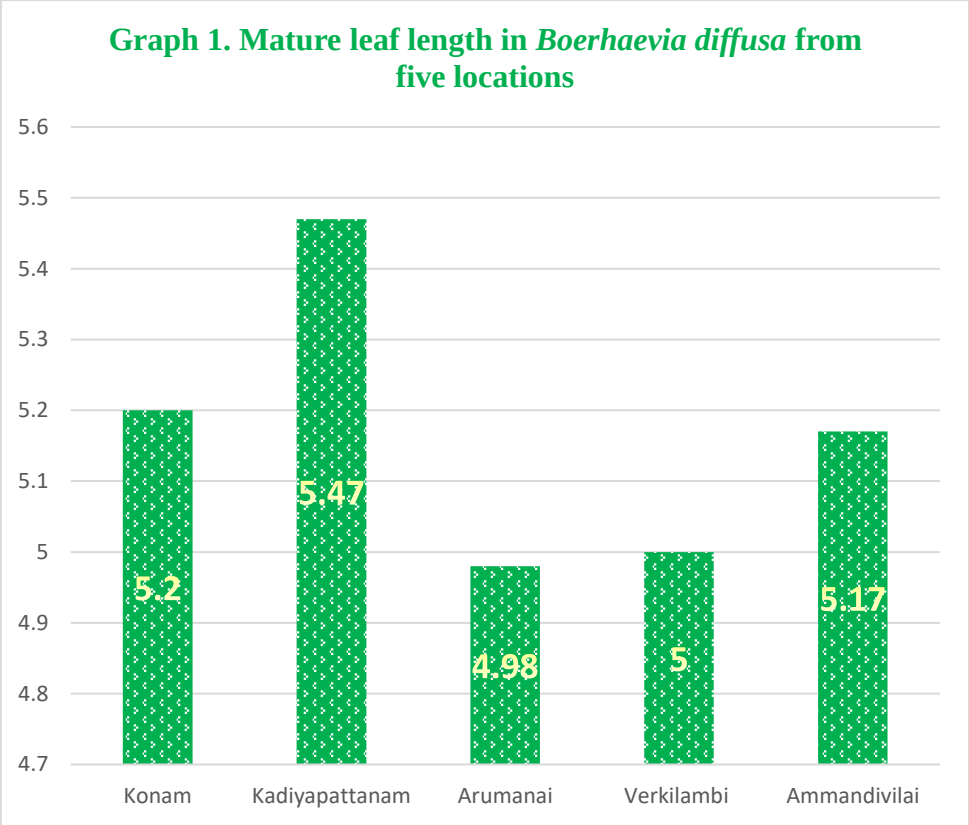
The blossoms of the plant are characterized by their diminutive size and range in colour from pale to dark pink, featuring a short stem. This observation aligns with previous findings documented by [2,5,8], indicating a consistent coloration of the blossoms in our research region.

**Table 1. Morphological variations between *Boerhavia diffusa* from Five Altitudes**

| Location | Mature leaf length [cm] | Mature leaf width [cm] | No of leaves | Stem length [cm] | Stem width [cm] | No of branches | Root length [cm] | Root width [cm] | Inflorescence length [cm] | No of flowers |
|---|---|---|---|---|---|---|---|---|---|---|
| **Konam** | 5.2±2.07 | 2.98±1.15 | 83.8±53.83 | 67.69±47.25 | 0.33±0.12 | 16.2±10.30 | 9.99±2.89 | 0.47±0.16 | 4.11±3.59 | 11.5±6.25 |
| **Kadiyapattanam** | 5.47±1.68 | 3.12±1.46 | 55.6±24.91 | 71.81±34.06 | 0.39±0.16 | 18.7±7.14 | 10.51±3.39 | 0.59±0.15 | 5.33±2.73 | 12.9±8.11 |
| **Arumanai** | 4.98±1.82 | 2.84±1.14 | 57.8±20.78 | 58.29±43.45 | 0.39±0.16 | 20.4±11.43 | 8.7±2.66 | 0.49±0.17 | 5.33±3.27 | 10.6±5.44 |
| **Verkilambi** | 5±2.68 | 3.06±1.30 | 61.6±32.18 | 57.71±31.11 | 0.36±0.12 | 12.8±5.97 | 8.52±3.04 | 0.46±0.15 | 3.22±3.01 | 15.3±7.21 |
| **Ammandivilai** | 5.17±1.55 | 3.63±1.24 | 56.7±27.86 | 78.36±42.96 | 0.44±0.17 | 16.7±8.47 | 10.81±3.03 | 0.49±0.13 | 4.39±2.75 | 10.1±6.08 |

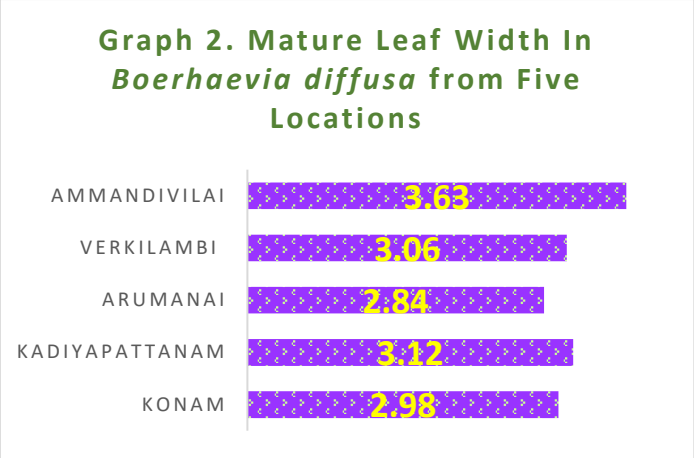
**Mature Leaf Length**

*Boerhavia diffusa*, characterized by its prostrate, pubescent nature and diffuse branching, tends to be nearly prostrate due to the rapid multiplication of relay axes along the main axis [8]. The stem, occasionally reddish or greenish, is enlarged at the nodes [8]. In our study, plants from different locations displayed variations in stem colour, with purple or greenish stems that were swollen at the nodal region. The maximum leaf length was observed in Kadiyapattanam plants (5.47±1.68 cm), followed by Konam (5.2±2.07 cm), Ammandivilai (5.17±1.55 cm), and Verkilambi (5±2.68 cm), while the shortest leaf length was noted in plants from Arumanai (Graph 1).



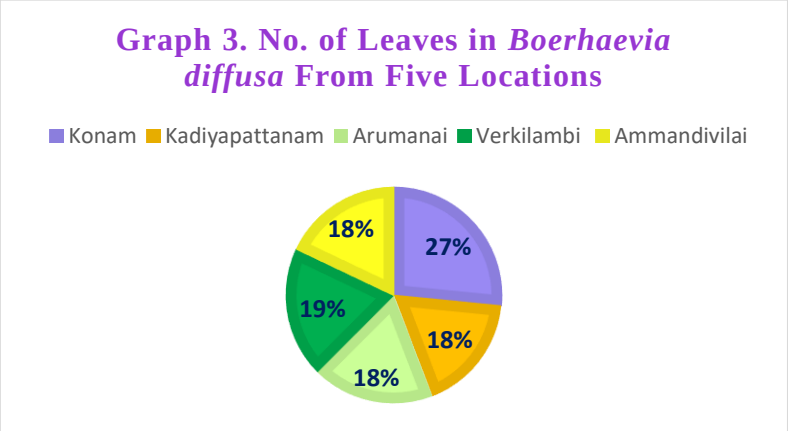

**Leaf Width at Maturity**

Plants from Ammandivilai exhibited the widest leaf width (3.63±1.24 cm), potentially influenced by higher rainfall and soil richness. Kadiyapattanam had the second-largest leaf width (3.12±1.46 cm), while Verkilambi plants had the smallest leaf width (2.84±1.14 cm) (Graph 2).



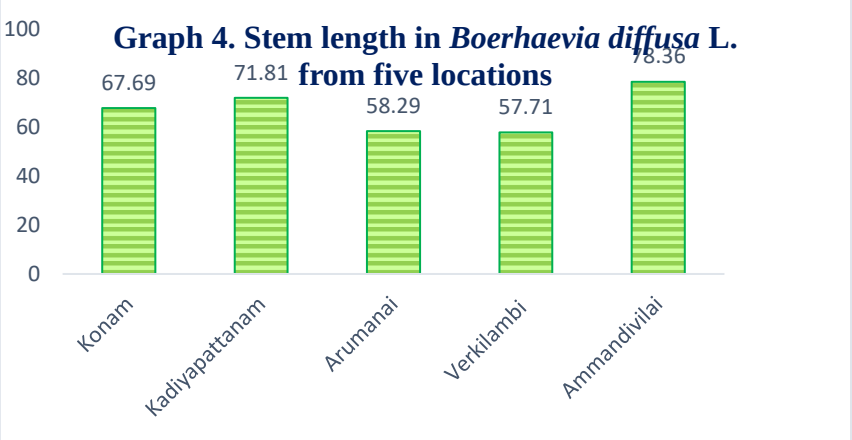

**Number of Leaves**

The maximum number of leaves was found in plants from Konam. Significant differences in leaf number were observed among plants from the five locations (Graph 3).



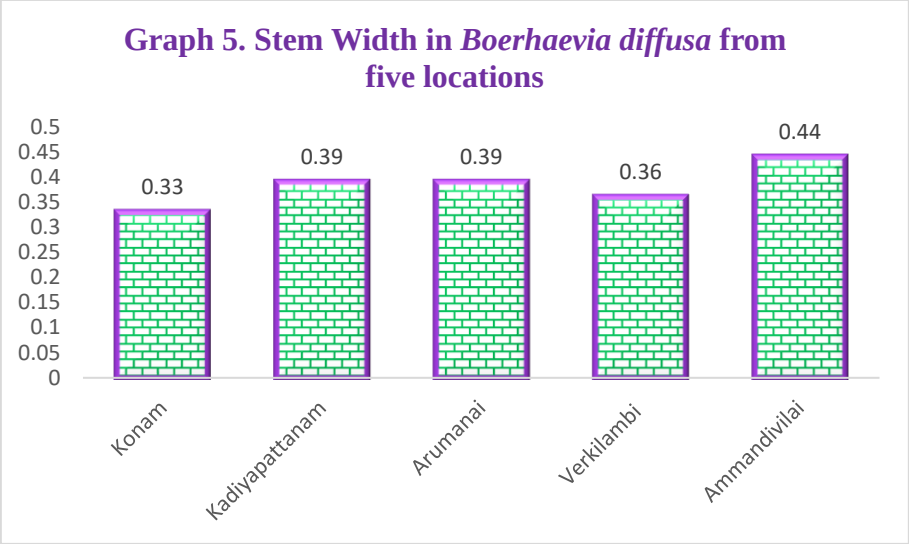

**Stem Length**

Plants from Ammandivilai exhibited longer stems, while those from Verkilambi had shorter stems compared to the sizes reported by [8]. Stem lengths varied from 90 to 158 cm across the surveyed areas (Graph 4).



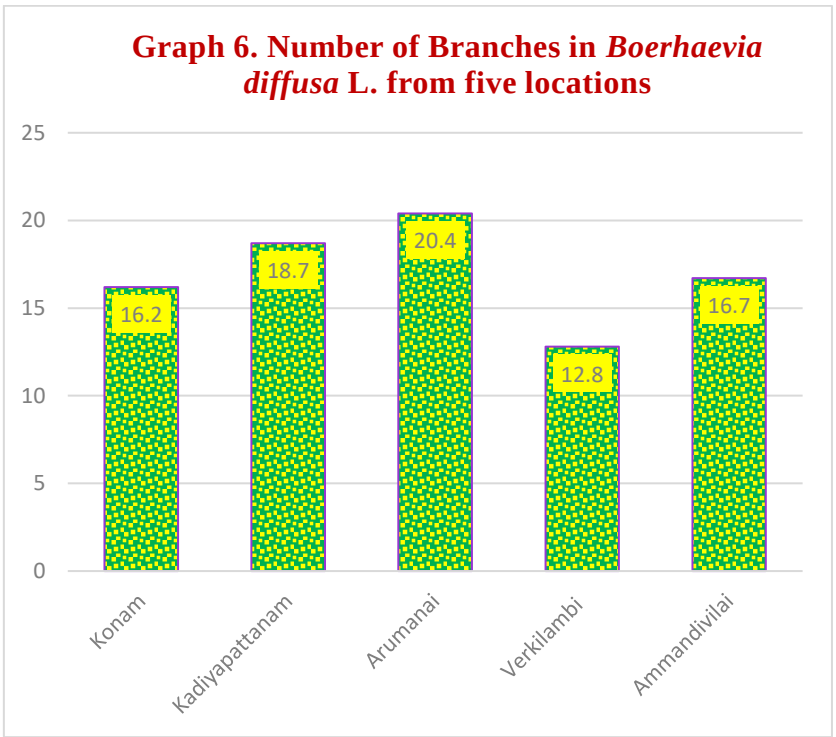
**Stem Width**

Kadiapattanam and Arumanai showed statistically comparable stem diameters (0.39±0.16 cm), while stem width significantly differed between Ammandivilai and Konam. Average stem width remained consistent across all locations. (Graph 5)



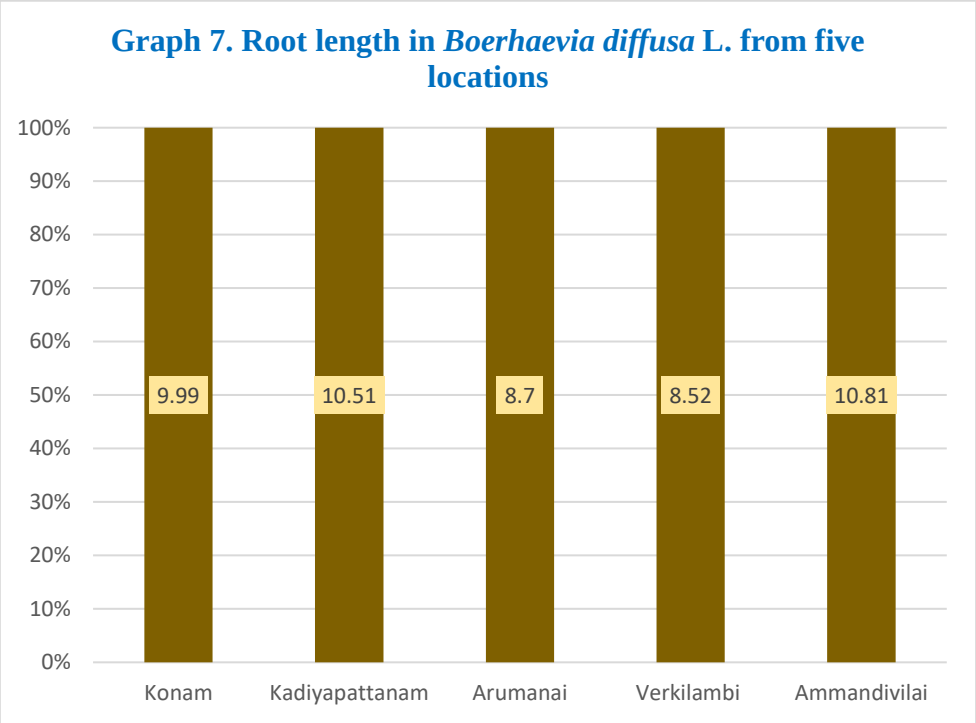

**Stem – Number of Branches**

Arumanai plants had the highest number of branches (20.4±11.43), followed by Kadiyapattanam (18.7±7.14), while Verkilambi plants exhibited the lowest number of branches (12.8±5.97) (Graph 6).



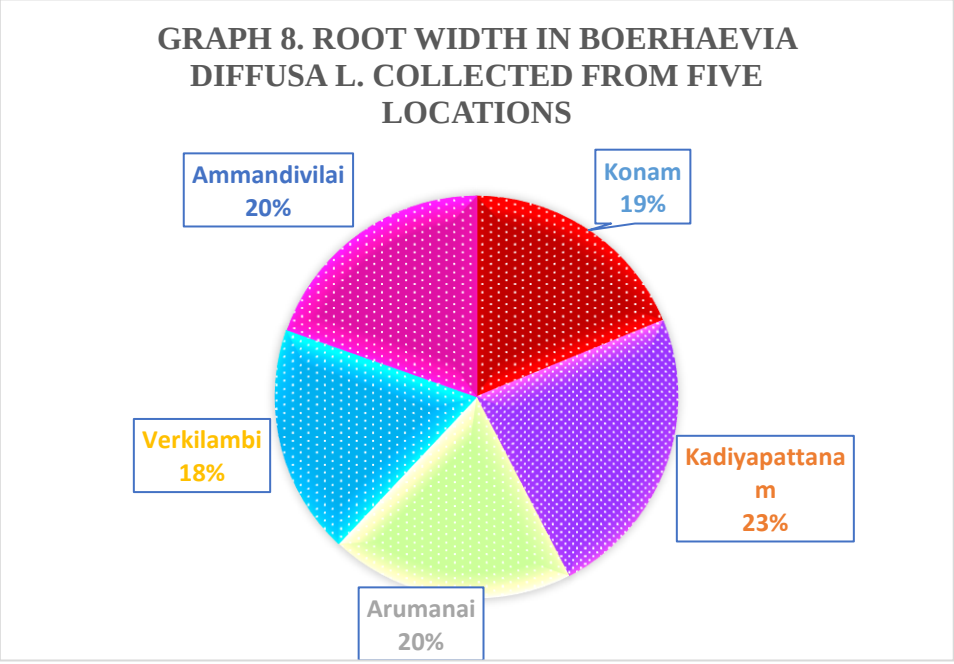
**Root Length**

Contrary to the thick, woody roots reported by [8], the root lengths varied dramatically across locations. Ammandivilai plants had the longest roots (10.81±3.03 cm).




**Root Width**

Arumanai and Ammandivilai plants exhibited nearly identical root widths, while significant variations were observed among plants from different study regions. (Graph 8)

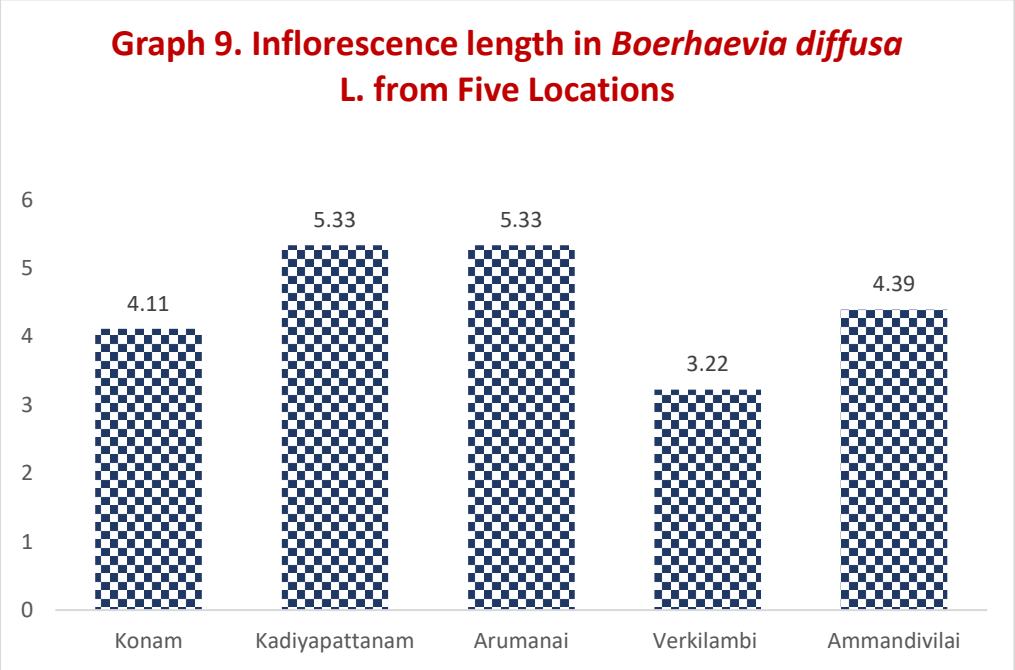


**Inflorescence Length**

Kadiapattanam and Arumanai had the longest inflorescence lengths, while Verkilambi had the shortest (3.22±3.01 cm). Light intensity and environmental conditions influenced these variations (Graph 9).

**Table 2. Collection data of *Boerhavia diffusa* L. from five Locations**

| Sl.no | Location | Latitude | Longitude | Date of collection |
|---|---|---|---|---|
| 1 | Konam | 8.158083° | 77.400496° | 23/1/2022 |
| 2 | Kadiapattinam | 8.128934° | 77.3087° | 26/01/2022 |
| 3 | Muzhucode | 8.366105° | 77.224582° | 26/01/2022 |
| 4 | Verkilambi | 8.299183° | 77.285855° | 26/1/2022 |
| 5 | Ammandivilai | 8.145234° | 77.310417° | 26/01/2022 |




**Number of Flowers**

Verkilambi exhibited the highest values for flower number compared to the other locations, possibly due to fertile soil and favourable climate (Graph 10). This aligns with [16] findings on morphological variation and reproductive output.

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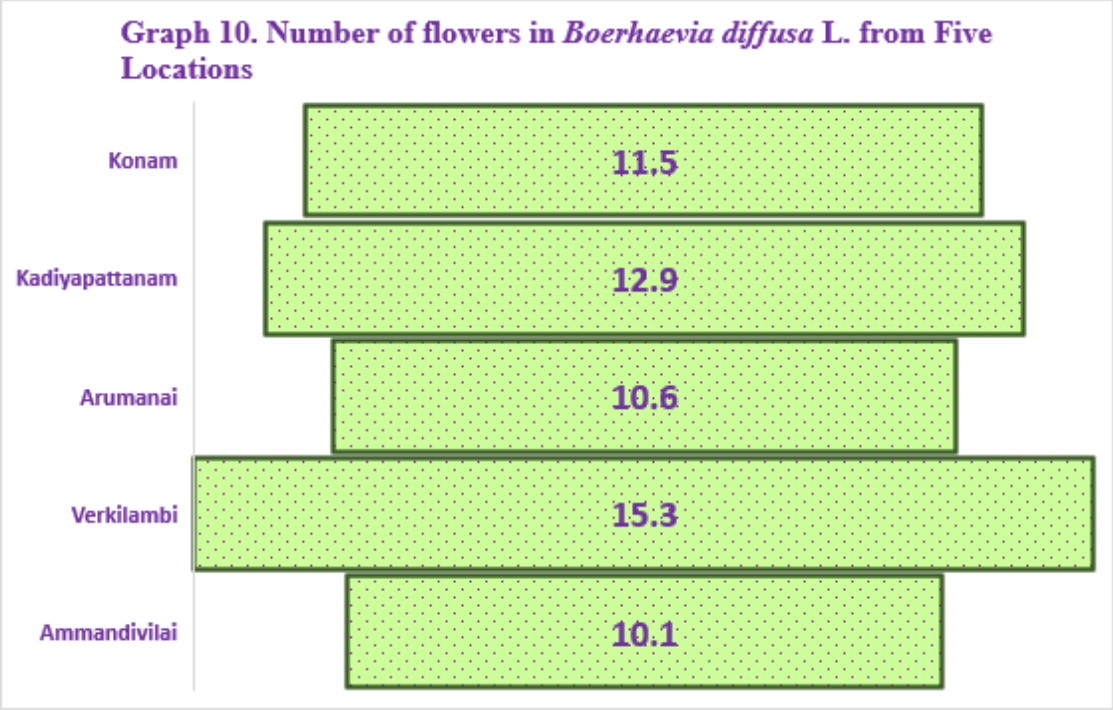
| 5 | Ammandivilai | 8.145234° | 77.310417° | 26/01/2022 |

**The collection data, including location, latitude, longitude, and date of collection, were tabulated in Table 2.**




## Conclusion

This study systematically investigated the morphological variations of *Boerhavia diffusa* across five locations in the Kanyakumari district, analysing five genetically diverse genotypes. Significant differences were observed in key characteristics, including mature leaf length, leaf width, number of leaves, stem length, stem width, number of branches, root length, root width, inflorescence length, and number of flowers. Notably, plants from Kadiyapattanam exhibited the longest leaves, while from Ammandivilai featured the widest leaves, and Konam displayed the highest leaf count. Stem length variations were noted, with Ammandivilai having

longer stems, while stem width remained consistent. Arumanai plants exhibited the highest number of branches, and Verkilambi showed the highest flower count. The study's novelty lies in its contribution to understanding the geographic influence on *Boerhavia diffusa*'s morphological diversity, offering insights for cultivation, conservation, and future research on adaptability in distinct agroclimatic zones, thereby enhancing our scientific knowledge of plant biology.

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