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PHENOTYPIC PROFILING OF BARLERIA GENOTYPES BASED ON FLORAL ARCHITECTURE

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ABSTRACT

This study was conducted in College of Horticulture, Anantharajupeta, to evaluate five barleria genotypes (ARB-1 to ARB-5) for phenotypic profiling based on floral architecture. Observations confirmed a conserved floral architecture typical of Acanthaceae, such as pentamerous corolla, didynamous stamens and bilabiate infundibuliformous flowers, indicative of strong genetic stability. Significant genotypic variations were noted in floral pigmentation, corolla tube length, flower diameter, anthesis timing, stigma receptivity, and pollen fertility. ARB-1 exhibited the largest flower diameter (4.08 cm) and corolla tube length (6.16 cm), while ARB-5 produced smaller blooms (2.83 cm). Anthesis time was earliest in ARB-1 (5.45 A), with stigma receptivity spiking after anthesis (1PM). Pollen fertility reached 99.9% following dehiscence between 10:00 AM and 12:00 noon, aligning with peak pollinator activity. These results establish Barleria as a genetically stable yet phenotypically diverse genus with significant ornamental and ecological potential, warranting further genotype-specific evaluations for floricultural improvement.

Key words: Barleria, floral biology, stigma receptivity, pollen fertility, anthesis

Introduction

Flowers are vital place in India's cultural and spiritual landscape, valued for their aesthetic appeal and diverse uses in medicine, food, dye extraction and adornment (Naik *et al.*, 2024). Floral coloration plays a crucial role in attracting pollinators and enhancing reproductive success. The genus *Barleria* originates from Jacques Barrelier, a French botanist and Dominican monk (Froneman & Roux, 2007). Among flowering genera, *Barleria* is one of the largest genera in the Acanthaceae family, with 300 species from the world with 30 native to tropical East Africa and Asia, including *B. cristata*, *B. buxiflora*, *B. repens* and others (Kumari *et al.*, 2017). The genus is notable for its hardiness, medicinal value and untapped ornamental potential (Gosavi *et al.*, 2011). In India, vernacular names of Barleria include December Puvvulu and Peddagorinta in Telugu, Raktajhinti in Hindi, Banpatoli in Odiya, Nilamulli and Semmuli in Tamil, Artagala, Bana, Dasi in Sanskrit, and Jati, Jhinti, Swetjhanti in Bengali. In Madhya Pradesh, it is known as Morani,

Mukaro, in Arunachal Pradesh as Vahaka and in Assom as Sajhia. It is commonly known as December flowers due to its blooming season.

Barleria cristata (Philippines violet), native to South and Southeast Asia, thrives in dry habitats and serves multifunctional roles as an ornamental hedge, erosion controller and floral element in garlands and adornments. Its dried capsules have economic importance in crafts, while its leaves, roots and seeds are employed in traditional medicine to treat ailments including toothaches, swelling, anemia, coughs, and snakebites (Naik *et al.*, 2024). Morphologically, it features bushy quadrangular stems, ovate-lanceolate leaves arranged decussately and violet bell-shaped flowers in monochasial cymes. Flowering occurs briefly in early winter in North India and from November to January in South. (Balkwill & Balkwill, 1998).

Barleria repens, a trailing African native, bears blue-purple to red-mauve flowers and is valued for erosion control, ground cover and ornamental hanging baskets

Table 1: Comparative floral pigmentation and phenological diversity in *Barleria* genotypes: patterns of anther pigmentation and dehiscence.

Geno- types	Place of collection	Petal colour	RHS colour code	Anthesis time	Pre-dehiscent anther pigmentation	Dehiscence time (am)	Post-dehiscent anther pigmentation
ARB-1	Rly.Koduru	Violet	Violet group N 87 B(strong purple)	5:45 AM - 7:00 AM	Light white, minimal pigmentation	6.30-7.20 (50 min)	Light ash purple
ARB-2	Rly.Koduru	White	White group NN 155 D(white)	6:00 AM - 8:45 AM	Pure white, Luminous clarity	6.30- 9.15 (2 hr 45 min)	Deep cream
ARB-3	Kadiyam	White	White group NN 155 D(white)	7:00 AM- 9:00 AM	White to light cream gradient	7.35-9.40 (2 hr 5 min)	Light cream to black
ARB-4	Kadiyam	Red	Red group 50 A(Strong red)	6:00 AM - 8:45 AM	Vivid reddish - pink tint	7.30-8.55 (1 hr 25 min)	Rich violet
ARB-5	Kadiyam	Light pink	Red-purple group 63 D (light purplish pink)	6:00 AM - 7:00 AM	Faint whitish- pink with subtle blush	6.45-7.45 (1 hr)	Noticeably white

(Gibango *et al.*, 2024 & Manoj *et al.*, 2022). Despite its ecological adaptability, *Barleria* remains underutilized flower crop in India, highlighting the need for genotype-specific evaluation across agro-climatic zones.

Material and Methods

The phenotypic study based on floral characters was conducted at the Floriculture block of the College of Horticulture in Anantharajupeta, Annamayya district, Andhra Pradesh, during the *Rabi* season of 2024-2025. The experiment was laid out in a Randomized Block Design (RBD) with five genotypes and four replications, using a 1m × 1m spacing following ridge and furrow method of planting.

Experimental details

Barleria genotypes were collected as rooted stem cuttings (8-10 cm long, 4-5 nodes, pencil thickness) from different locations. The cuttings were prepared for rooting by removing the lower leaves and making a slant cut at

Table 2: Quantitative assessment of flower size and reproductive organ proportions in *barleria* genotypes.

Geno- types	Corolla tube length (cm) (fully opened flower)	Flower diameter (cm)	Relative length of style and stamens (long) (cm)
ARB-1	6.16	4.08	1.06
ARB-2	5.13	3.33	1.07
ARB-3	3.95	3.05	0.87
ARB-4	3.92	3.20	0.47
ARB-5	3.74	2.83	0.77
MEAN	4.58	3.30	0.85
S.Em±	0.11	0.25	0.11
CD (<i>P</i> =0.05)	0.33	0.72	0.31

the basal node before planting them in polybags. These cuttings were dipped in freshly prepared IBA at 1000 ppm (Nithin *et al.*, 2021) before being planted directly into polybags with an ideal potting mixture. Immediately after planting, the cuttings were lightly irrigated. Subsequently, irrigation was given at regular intervals. Uniform and healthy rooted cuttings were transplanted in the main field after 75 days (Kunjamma *et al.*, 2022). Gap filling was carried out using healthy cuttings within one month. Regular cultivation practices were adopted both before and after transplanting, along with the necessary plant protection measures.

Results and Discussion

Floral Biology Traits

For performance assessment, five plants were tagged randomly in each replication and observations for various floral biology traits were recorded and average values were calculated.

The floral formula of *Barleria*, a genus within the Acanthaceae family, can be conventionally represented

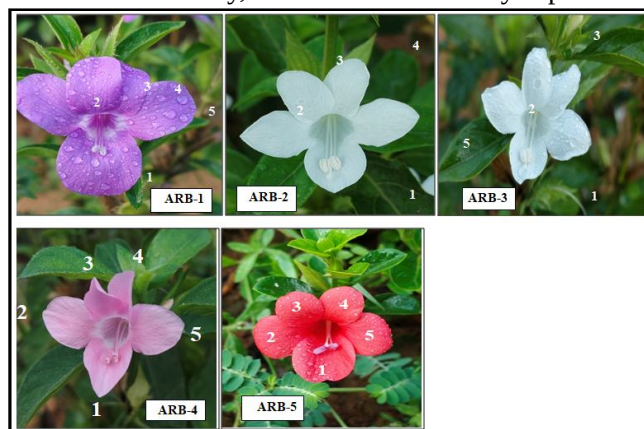
**Fig 1:** Fivefold harmony: Petal uniformity in *Barleria* genotypes.

Table 3: Stigma receptivity dynamics in *Barleria*: genotypic response over time.

Geno- types	Pre- anthesis (5 AM)	Anthesis stage (9 am)	Post- anthesis stage (1 pm)	Post- anthesis stage(5 pm)
ARB-1	+	++	+++	++
ARB-2	+	++	+++	++
ARB-3	+	++	+++	++
ARB-4	+	++	+++	++
ARB-5	+	++	+++	++

as $\text{Br \% } \text{\textcircled{f}} \text{ K}_{(4)} \text{ C}_{(5)} \text{ A}_{(4)} \text{ G}_{(2)}$. This indicates that the flower is zygomorphic (%), bracteate (Br), bisexual ($\text{\textcircled{f}}$) with a calyx of four sepals $\text{K}_{(4)}$, the outer pair much larger, foliaceous, reticulate, spinescent at the margin and the inner pair small, pubescent and a corolla of five fused petals $\text{C}_{(5)}$, typically forming a tubular or bell-shaped structure. The androecium consists of four didynamous stamens $\text{A}_{(2+2)}$ and the gynoecium comprises superior, oblong two fused carpels $\text{G}_{(2)}$, usually with 2 ovules in axile placentation. This structural arrangement is consistent across genotypes such as ARB-1 to ARB-5, despite variations in flower size, corolla tube length, and anthesis timing. The formula reflects the genus’s adaptive floral traits, supporting both ornamental appeal and pollinator specificity that aligns with broader patterns in various species of *barleria*. (Darbyshire 2019 & 2021)

Morphological assessment confirmed five petals arranged in a (4+1) pattern, typically fused at the base, forming a bilabiate, infundibuliform corolla with zygomorphic symmetry. Petal textures were smooth and glabrous, showing asymmetry in dimension and pigmentation among genotypes. This stable pentamerous and bilabiate configuration plays a vital role in attracting pollinators such as bees and butterflies, reflecting high genetic conservation (Myint *et al.*, 2020; Namedo *et al.*, 2021). RHS colour chart analysis revealed considerable floral pigmentation variability (Table 1), akin to findings in *Crossandra* genotypes (Bhosle *et al.*, 2018; Supriya *et al.*, 2024).



Fig. 2: Visualizing floral hue using RHS color chart reference in *Barleria* genotypes.

The floral structure of *Barleria* genotypes showed a consistent pattern in the androecium, with each flower having four fertile stamens arranged didynamously (2 long + 2 short), a typical feature of the Acanthaceae family. Both pairs of stamens were functional, although the lower pair consistently produced lighter pollen loads, indicating subtle functional asymmetry. This uniformity across genotypes reflects strong genetic conservation of reproductive traits as supported by Basu (2023), Manzitto-Tripp *et al.*, (2022). The style usually extends beyond the shorter stamens, but nearly equal in length to the longer stamens. Variations in style–stamen proximity among genotypes ranged from 0.47 cm (ARB-4) to 1.07 cm (ARB-2), with intermediate values in ARB-3 and ARB-5 as shown in Table 2. Despite these minor differences, the style consistently matched or exceeded the length of the upper stamens, indicating strong genetic control. These results are in agreement with Kalaiyarasi *et al.*, (2019), who observed similar positioning of stamens and styles in *Jasminum* spp. A concise evaluation of flower opening in evaluated *Barleria* genotypes revealed a consistent anthesis window between 5:45 AM and 9:00 AM, aligning with peak diurnal pollinator activity. ARB-1 was the earliest bloomer (5:45–7:00 AM), while ARB-2 and ARB-4 stands next (6:00–8:45 AM), narrowest window range was found in ARB-5 (6:00–7:00 AM) and ARB-3 showed (7:00–9:00 AM) flowering duration. Despite minor differences, all genotypes exhibited a stable morning rhythm, reflecting genetic regulation and ecological adaptation echoing findings by Kalaiyarasi *et al.*, (2019) in *Jasmine* and Basu *et al.*, (2023) in *Barleria* spp.

Details pertaining to anther colour and dehiscence are presented in Table 1. The position of anthers in corolla tube is midway in a flower and are dorsifixed, an arrangement that facilitates effective pollen release and aligns with frequent pollinator contact zones. This conserved floral architecture, documented by Myint *et al.*, (2020) reflects a refined reproductive strategy shaped by evolutionary pressures to enhance pollination accuracy

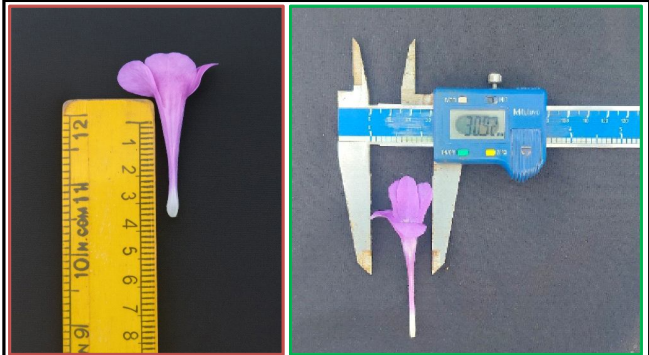


Fig. 3: Assessment of corolla tube length and flower diameter in *Barleria* (ARB-1).

and ecological success. These intra-genotypic differences, though modest, may serve as visual cues for pollinator attraction and offer phenotypic markers for genotype identification, consistent with floral trait plasticity discussed in crops like *Barleria greeni* (Makholela *et al.*, 2003), *Jasminum* spp. (Kalaiyarasi *et al.*, 2019), and *B. prionitis* (Basu *et al.*, 2023).

Flower diameter ranged from 2.835 cm to 4.088 cm, with ARB-1 (violet) exhibiting the largest bloom (4.088

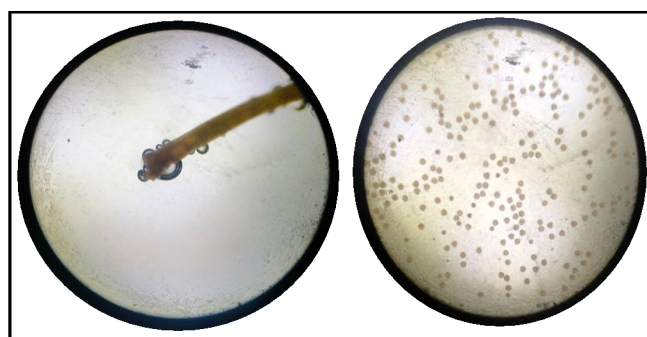


Fig. 5: (A) Microscopic view of stigma receptivity of fully opened *Barleria* flowers; (B) Microscopic view of pollen fertility in *barleria* flowers.

cm) and longest corolla tube (6.16 cm), enhancing ornamental value and pollinator compatibility. Other genotypes varied accordingly, suggesting genotypic floral size diversity (Table 2). A positive correlation between diameter and tube length suggests a synergistic floral strategy. These patterns mirror genotypic variations in *Barleria* (Nithin *et al.*, 2021) with comparable traits in *Crossandra* (Bhoomika & Shiju, 2024). The details pertaining to flower diameter and corolla tube length are presented in the Table 2.

Stigma receptivity (Table 3) followed a consistent pattern per the 6% hydrogen peroxide test (Monika and Akarshg, 2017), followed a consistent pattern: mild at pre-anthesis (5 AM), increasing at anthesis (9 AM), peak at post-anthesis (1 PM) and declining by 5 PM. This progression reflects stigma maturation and optimal fertilization timing shortly after full bloom. Patterns were consistent across genotypes, aligning with findings in *Jasminum* spp. and *Carica papaya* (Kalaiyarasi *et al.*, 2019; Ferreira *et al.*, 2021).

Pollen fertility got hiked after anther dehiscence between 10:00 AM and 12:00 PM, maintaining 99.9% viability till flower senescence in the evening, supporting optimal fertilization during peak pollination times. This is consistent with reproductive timing in other horticultural species (Ahmad *et al.*, 2010).

Conclusion

This study provides valuable insights into the floral biology of *Barleria* genotypes, revealing a genetically conserved floral architecture typical of Acanthaceae alongside phenotypic diversity in flower color, corolla tube length, anthesis timing, stigma receptivity, and pollen fertility. All genotypes exhibited stable floral architecture typical of the Acanthaceae family, with consistent petal number, didynamous stamens and bilabiate corolla, indicating strong genetic conservation. However, variations in flower colour, corolla tube length, anthesis timing, stigma receptivity and pollen fertility highlighted

valuable intra and inter genotypic diversity. Among the five genotypes studied, ARB-1 (violet) recorded the largest flower size and earliest anthesis, while ARB-2 (white) demonstrated prolonged anther dehiscence, enhancing its pollination window. Such diversity across genotypes reflects adaptive strategies for ecological success and offers potential for ornamental improvement and commercial exploitation. Overall, the findings revealed that barleria, though underutilized in Indian floriculture, holds immense promise as an ornamental crop with added medicinal and ecological benefits. Genotype-specific evaluation, as undertaken in this study, provides a foundation for future breeding programmes, conservation strategies and wider horticultural adoption of *Barleria* species across diverse agro-climatic zones.

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