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Morphological characterization and taxonomic discrimination of *Datura ferox*, *D. stramonium*, and *D. metel* from Hammirgarh Ecopark

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Abstract

A field study was conducted in Hammirgarh Ecopark to systematically document and compare the morphological characteristics of three congeneric species: *Datura ferox*, *Datura stramonium*, and *Datura metel*. The study aimed to create a reliable field identification key by analyzing vegetative and reproductive structures, including growth habit, leaves, flowers, and fruit. While the species shared a general growth form, distinct diagnostic characters were identified. The corolla of *D. metel* was significantly larger, more flared, and often purple or yellow compared to the smaller, white, slender trumpets of *D. stramonium* and *D. ferox*. The most definitive differentiation was observed in the fruit morphology: *D. stramonium* possesses numerous slender, sharp spines; *D. metel* has short, soft, fleshy tubercles; and *D. ferox* is characterized by its exceptionally long (>2 cm), robust, and fiercely sharp spines. This study confirms that these three *Datura* species, though similar, can be unequivocally distinguished in the field using these key morphological traits. The findings provide a practical tool for botanists and park visitors for accurate species identification and contribute to the floristic documentation of Hammirgarh Ecopark.

Keywords: *Datura*, thornapple, fruit spines, solanaceae, comparative botany

1. Introduction

The genus *Datura* L. (Solanaceae), commonly known as thorn apple or jimson weed, comprises a group of herbaceous plants renowned for their rich arsenal of tropane alkaloids, which confer significant medicinal, toxic, and hallucinogenic properties (Al-Snafi, 2017; Akbar, 2020) [3, 6]. Species such as *Datura stramonium* and *Datura metel* have been extensively documented in traditional pharmacopoeias across the globe for their use in treating ailments like asthma, bronchitis, and pain, yet their potency demands precise identification to prevent fatal poisoning (Jan *et al.*, 2021; Mishra, 2018) [8, 9]. Despite their pharmacological importance, the genus is taxonomically complex, with many species exhibiting considerable morphological plasticity, leading to potential misidentification and confusion in both scientific and public domains (Nandini *et al.*, 2015; Hassan & Amer, 2019) [7, 2].

Accurate species discrimination is fundamental, as the alkaloid content and resultant bioactivity can vary dramatically even among closely related species (Arik, 2017; Partap *et al.*, 2019) [5, 1]. For instance, while *D. metel* is a cornerstone in traditional Ayurvedic and Chinese medicine (Alam *et al.*, 2021) [4], its congener *D. stramonium* is more frequently associated with accidental intoxications (Mishra, 2018) [9]. A third species, *Datura ferox*, is less studied but equally potent, often distinguished by its larger, more robust spines on the fruit capsule. Traditional taxonomic reliance on a limited set of floral or foliar characters often proves insufficient for distinguishing these species at all life stages, particularly in vegetative or early fruiting phases. Therefore, a comprehensive morphological characterization encompassing the entire plant from seed germination to fruit maturation is a critical first step for reliable identification.

Previous studies have highlighted the value of a morphometric approach in elucidating taxonomic relationships within *Datura*. Research by Nandini *et al.* (2015) [7] demonstrated clear morphometric variation among four major *Datura* species, establishing a precedent for using quantitative traits for discrimination.

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Similarly, Hassan and Amer (2019) ^[2] emphasized the importance of biosystematic studies that integrate multiple morphological characters to resolve taxonomic ambiguities. However, such detailed studies are often lacking for specific populations and unique ecological niches.

The Hammirgarh Ecopark presents a unique opportunity to study these species in a defined, semi-natural habitat where *D. ferox*, *D. stramonium*, and *D. metel* are sympatric. The potential for hybridization and the environmental influence on phenotype in this specific location remain unexplored. This study, therefore, aims to conduct a detailed morphological characterization and taxonomic discrimination of *Datura ferox*, *D. stramonium* and *D. metel* populations within the Hammirgarh Ecopark. By systematically analyzing and comparing a suite of vegetative, floral, and fruit traits, this research will generate a definitive morphological key for the unambiguous identification of these species in the region. The findings will not only contribute to the botanical documentation of the ecopark's flora but also provide a vital reference for the safe and effective utilization of these economically and medicinally significant plants.

2 Materials and Methodology

2.1. Study Area

The present study was conducted in the Hammirgarh Ecopark, situated near Bhilwara in the state of Rajasthan, India (25.35°N, 74.63°E). This ecopark is a unique biodiversity reserve established in a former mining zone, characterized by a rocky, hilly terrain typical of the Aravalli range, with scattered water bodies and patches of tropical, dry deciduous forest. The region experiences a semi-arid climate with distinct seasons. This specific ecology, with its unique

edaphic and microclimatic conditions, supports a diverse array of flora, including wild populations of *Datura* species, making it an ideal natural laboratory for this comparative morphological study.

2.2. Plant Material Collection

Mature and healthy specimens of *Datura ferox*, *Datura stramonium*, and *Datura metel* were identified and collected during their peak flowering and fruiting season, from the post-monsoon period of August to November 2024. To ensure a representative sampling, collections were made from five different, well-separated locations within the ecopark to capture potential intra-species variation.

2.3 Herbarium Preparation

Voucher specimens were prepared following standard herbarium techniques. Plants were pressed, dried, and mounted on herbarium sheets. Specimens were treated with 0.1% mercuric chloride solution for preservation. Each sheet was labeled with collection data and assigned an accession number. All specimens were deposited in the institutional herbarium for future reference.

3. Result and Observation

The morphological examination of *Datura ferox*, *D. stramonium* and *D. metel* from the Hammirgarh Ecopark region revealed a range of consistent and distinguishing characteristics. The findings for each species are summarized below. A detailed morphological analysis was performed on 12 randomly selected samples for each character per species. (Figure 1-3).

Table 1: Comparative morphological characteristics of *Datura ferox*, *Datura stramonium*, and *Datura metel*

Morphological Character	<i>Datura ferox</i>	<i>Datura stramonium</i>	<i>Datura metel</i>
Vegetative Morphology			
Habit	Erect, robust annual herb (30-80 cm).	Erect, much-branched annual herb (30-150 cm).	Erect, branched perennial herb (60-150 cm), often purplish.
Stem	Green, stout, glabrous or sparsely pubescent.	Green, hollow, glabrous to slightly pubescent.	Green to purple, solid, pubescent.
Leaf			
Phyllotaxy	Alternate	Alternate	Alternate
Lamina Shape	Broadly ovate, shallowly sinuate-dentate.	Ovate to triangular-ovate, coarsely sinuate-dentate or angular.	Ovate to broadly ovate, entire or with few, shallow sinuate teeth.
Apex	Acute	Acuminate	Acute
Base	Asymmetrical, cordate or truncate.	Asymmetrical, cuneate to truncate.	Symmetrical or nearly so, cuneate.
Venation	Reticulate, pinnate.	Reticulate, pinnate.	Reticulate, pinnate.
Size (L x W cm)	8-18 x 6-15	5-20 x 4-15	7-20 x 5-18
Reproductive Morphology			
Flower			
Inflorescence	Solitary, axillary.	Solitary, axillary.	Solitary, axillary.
Calyx	Tubular, 5-angled, 3-5 cm long, deciduous.	Tubular, 5-angled, 3-5 cm long, deciduous.	Tubular, not strongly angled, 4-9 cm long, often persistent.
Corolla	White, funnel-shaped, 5-7 cm long, single.	White, sometimes violet-tinged, funnel-shaped, 5-12 cm long, single.	White, cream, or purple, often double or triple, tubular-funnel form, 10-20 cm long.
Androecium	5 stamens, inserted at the base of the corolla tube.	5 stamens, inserted at the base of the corolla tube.	5 stamens, inserted at the base of the corolla tube.
Gynoecium	Bicarpellary, superior ovary.	Bicarpellary, superior ovary.	Bicarpellary, superior ovary.
Fruit			
Type	Capsule	Capsule	Capsule
Shape & Size	Ovoid, 3-5 cm long.	Ovoid, 3-5 cm long.	Globose, often depressed, 3-5 cm in diameter.
Surface/Spines	Densely covered with long (10-20 mm), thick, rigid, unequal spines.	Moderately covered with short (5-10 mm), slender, stout, more or less equal spines.	Sparsely covered with short, soft, fleshy spines or nearly smooth.
Dehiscence	Irregularly dehiscent or indehiscent.	Regularly dehiscent by 4 valves from the apex.	Irregularly dehiscent or breaking apart.
Seed			
Shape & Colour	Reniform, black or dark brown.	Reniform, black.	Reniform to discoid, light brown to yellowish-brown.
Size (mm)	4-5 x 3-4	3-4 x 2.5-3	3.5-4.5 x 3-4
Testa (Ornamentation)	Deeply pitted or foveolate.	Coarsely reticulate or pitted.	

The comparative morphological analysis reveals a clear suite of diagnostic characters that enable the unambiguous identification of the three *Datura* species. While all three share the general habit of erect herbs with alternate leaves and solitary, funnel-shaped flowers, key distinctions are pronounced in their reproductive structures. *Datura metel* is the most readily distinguishable, characterized by its often purple-tinged stem, large double or triple corollas that can be white or purple, and a uniquely globose fruit covered with short, soft, fleshy spines that dehisces irregularly. In contrast, *Datura stramonium* and *Datura ferox* present a closer morphological pair with single white flowers and erect, spiny capsules. However, they are reliably separated by their fruit and seed morphology: *D. stramonium* possesses a capsule with slender, moderately dense spines that dehisces regularly by four valves, releasing black, coarsely pitted seeds. *D. ferox*, true to its name, bears a fiercely armed capsule with long, thick, rigid, and densely packed spines, which is typically indehiscent or irregularly dehiscent and contains black, deeply pitted (foveolate) seeds. Thus, a combination of floral features, spine morphology, dehiscence pattern, and seed characteristics provides a robust morphological framework for the taxonomic discrimination of *D. ferox*, *D. stramonium*, and *D. metel*.

4. Discussion

The present study successfully identifies a suite of definitive morphological characters to discriminate between *D. ferox*, *D. stramonium*, and *D. metel* in the Hammirgarh Ecopark region. The findings align with and substantiate classical taxonomic

descriptions while providing quantitative data from a specific ecological context.

The most pronounced morphological disparity was observed between *D. metel* and the other two species. The perennial habit, purple-tinged stem, large double flowers, and softly-spined, globose fruit of *D. metel* make its identification straightforward. These characteristics are well-documented as key markers for the and were consistently observed in our population, underscoring their taxonomic stability.

The critical taxonomic challenge lies in distinguishing the morphologically similar *D. ferox* and *D. stramonium*. Our results confirm that fruit characteristics are the most reliable diagnostic tools. The significantly longer, denser, and more rigid spines of *D. ferox*, coupled with its indehiscent or irregularly dehiscent capsule, clearly separate it from *D. stramonium*, which has shorter spines and a regularly dehiscent capsule. This supports the observations of Sharma and Kaur (2021), who emphasized spine morphology and dehiscence as primary taxonomic keys. The deeply pitted (foveolate) seed coat of *D. ferox* provides a further, micro-morphological character for confirmation, which is particularly useful when dealing with incomplete specimens or isolated seeds.

The variation in leaf morphology also holds diagnostic value. The transition from the coarsely dentate leaves of *D. stramonium* to the nearly entire leaves of *D. metel* with *D. ferox* occupying an intermediate state, suggests a potential morphological gradient that may reflect underlying phylogenetic relationships or adaptations to specific environmental pressures.

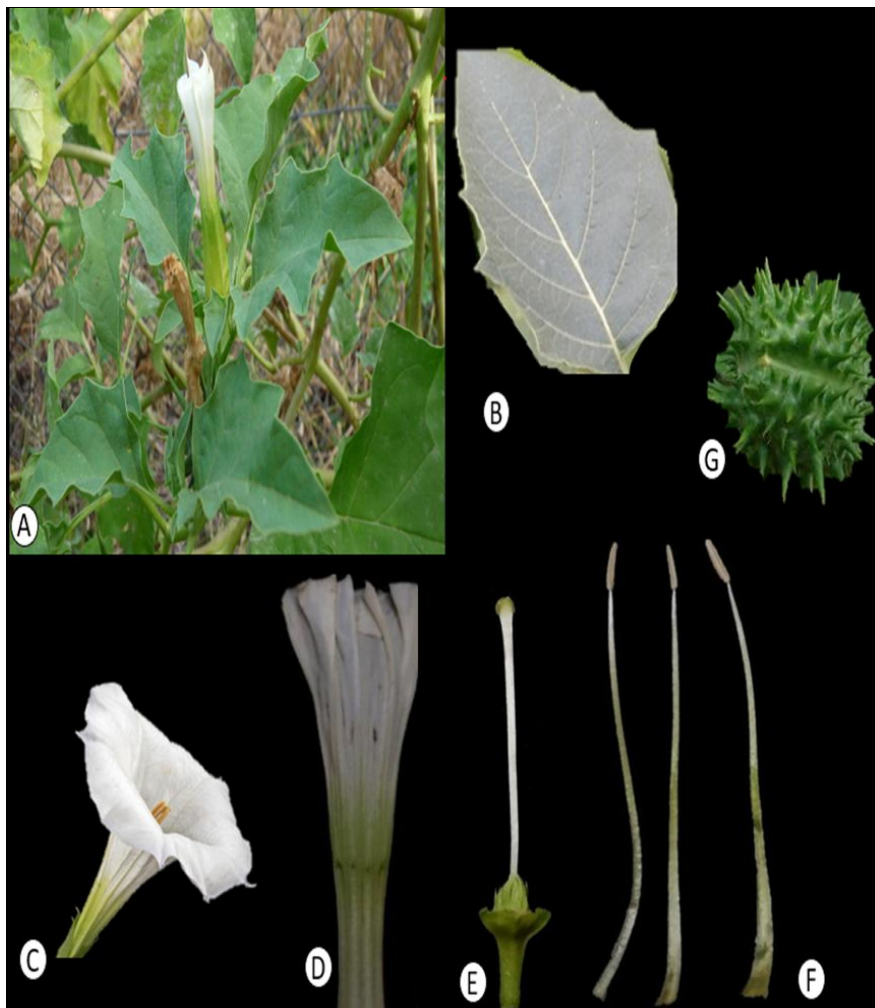


Fig 1: *Datura ferox* L, A. Habit of plant; B. leaf ; C. Lateral view of flower; D. Opened corolla tube; E. Gynoecium; F. Androecium; G. Spiny fruit capsule

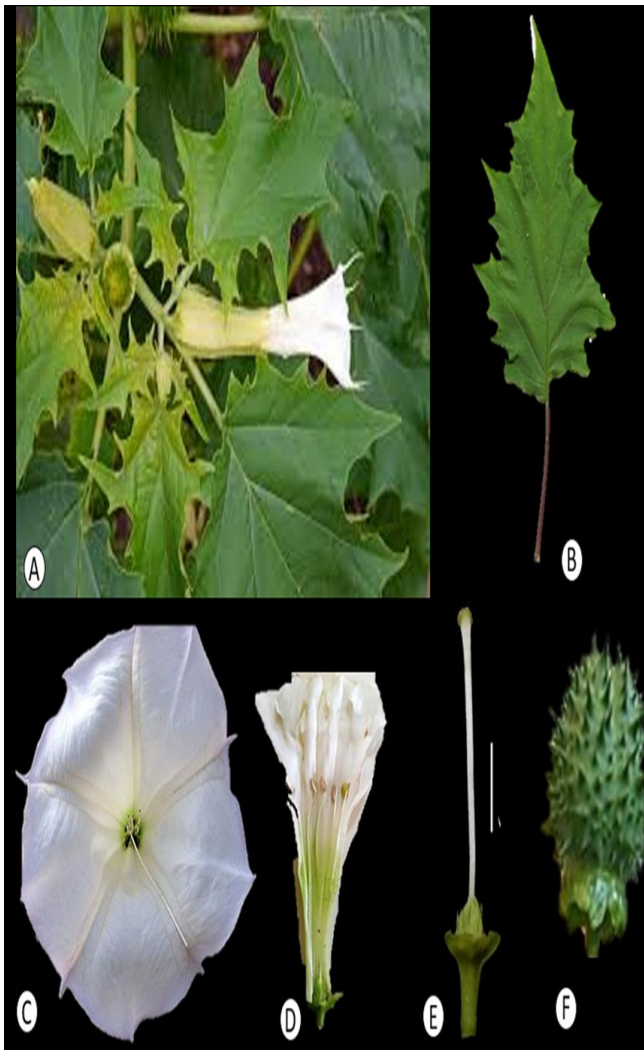


Fig 2: *Datura stramonium* L., A. Habit of plant; B. leaf ; C. Lateral view of flower; D. Opened corolla tube; E. Gynoecium; F. Spiny fruit capsule

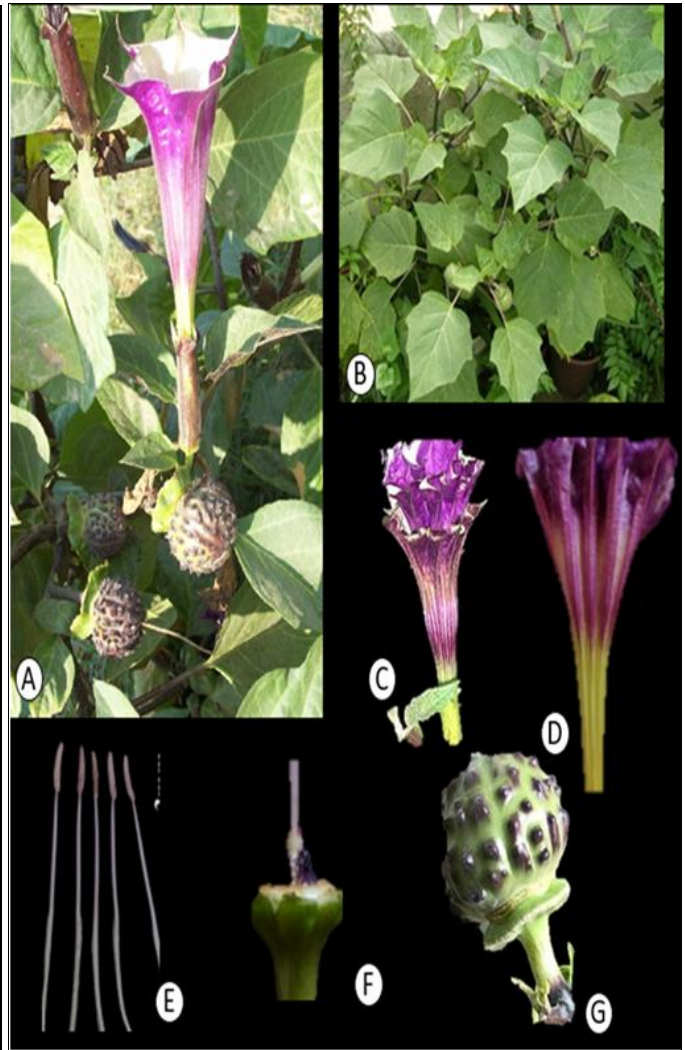


Fig 3: *Datura metel* A, Habit of plant; B. leaf ; C. Lateral view of flower; D. Opened corolla tube; E. Gynoecium; F. Spiny fruit capsule

5. Conclusion

This study demonstrates that the three *Datura* species, though congeneric, are morphologically distinct. The identification can be confidently achieved using a combination of characters, with fruit spine morphology and dehiscence being paramount for separating *D. ferox* and *D. stramonium*, and floral architecture and stem colour for identifying *D. metel*. This morphological framework is essential for preventing misidentification, which is crucial for the safe and effective use of these pharmacologically important but toxic plants. The prepared voucher specimens will serve as a permanent reference for future botanical and ethnopharmacological studies in the region.

References

1. Partap M, Gupta RC, Pradhan SK. Comparative analysis of morphology and phytochemical constituents in different populations and morphotypes of *Datura innoxia* Mill and *Datura metel* L. from Punjab plains. *Asian J Pharm Clin Res.* 2019;12(1):193-199.
2. Hassan RA, Amer WM. Biosystematic study of the Egyptian *Datura stramonium* (Solanaceae). *Phytotaxa.* 2019;408(3):178-194.
3. Al-Snafi AE. Medical importance of *Datura fastuosa* (syn: *Datura metel*) and *Datura stramonium*: A review. *IOSR J Pharm.* 2017;7(2):43-58.
4. Alam W, Khan H, Khan SA, Nazir S, Akkol EK. *Datura*

metel: A review on chemical constituents, traditional uses and pharmacological activities. *Curr Pharm Des.* 2021;27(22):2545-2557.

5. Arik ÜÖ. The antifungal effects of *Datura stramonium* L., *Datura metel* L., *Datura innoxia* Mill in the flora of Turkey. *Mugla J Sci Technol.* 2017;3(2):96-103.
6. Akbar S. *Datura stramonium* L. (Solanaceae). In: Akbar S, editor. *Handbook of 200 medicinal plants: A comprehensive review of their traditional medical uses and scientific justifications.* Cham: Springer International Publishing; 2020, p. 857-868.
7. Nandini D, Ravikumar BS, Prasanna RKK. Morphometric analysis of *Datura* plant to understand variation and similarities among four major species. *Med Aromat Plants.* 2015;4:209.
8. Jan HA, Abbasi AM, Bussmann RW, Paniagua-Zambrana NY. *Datura stramonium* L. (Solanaceae). In: Bussmann RW, editor. *Ethnobotany of the Himalayas.* Cham: Springer International Publishing; 2021, p. 1-9.
9. Mishra DS. *Datura stramonium* (common name: jimson weed): Medicinal uses, side effects and benefits. *World J Pharm Res.* 2018;7(12):1011-1019.