



## SEED POLYMORPHISM IN *CASSIA TORA* L.: MORPHOLOGICAL VARIATION AND ITS ECOLOGICAL SIGNIFICANCE

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*Cassia tora* L., a common herbaceous legume found in tropical and subtropical regions, exhibits notable seed polymorphism. This study investigates the morphological diversity of seeds in *Cassia tora*, categorizing them into three distinct morphological types. Morphometric parameters such as length, width, shape, color, surface texture, weight, dormancy, viability, and germination were analyzed. The results show significant variation among categories, which may contribute to ecological fitness, dispersal strategies, and adaptability. Understanding seed polymorphism is essential for assessing the ecological success and invasiveness of this species, particularly in biodiverse regions like the Sariska Tiger Reserve.

**Keywords:** *Cassia tora*, Ecological adaptation, Sariska Tiger Reserve, Seed dormancy, Seed morphology, Seed polymorphism.

### Introduction

Seed polymorphism—variation in seed traits within a single species is a critical adaptive trait that enhances survival in heterogeneous environments<sup>1</sup>. *Cassia tora* L. (syn. *Senna tora*), belonging to the Fabaceae family, is widely distributed across Asia and Africa, presently it is most common invasive weed during rainy season in Sariska tiger reserves<sup>2</sup> known for its medicinal, ecological, and economic importance<sup>3-5</sup>. This phenomenon is well documented in several plant families and is especially prominent in species occupying disturbed or variable . Seed polymorphism often correlates with varied germination responses, dispersal strategies, and seedling survival, thereby facilitating niche partitioning and species persistence<sup>6-8</sup>.

Polymorphic seeds in *Cassia tora* differ in size, shape, color, and dormancy levels. Such variability is linked to ecological advantages, including staggered germination, better colonization, and increased survival<sup>9</sup>. This study aims to characterize the morphological variation in seeds of *Cassia tora* and understand its ecological implications, with a particular

focus on the biodiversity-rich Sariska Tiger Reserve.

### Material and Methods

Mature fruits of *Cassia tora* were collected from the Kalighati forest and the Slopka forest of Sariska Tiger Reserve (27.33°N, 76.43°E) in Alwar district, Rajasthan in September and October and seeds were taken out and grouped into three categories based on visual and measurable morphological traits and separately stored in paper bags at room temperature in the laboratory. These seeds were used to determine various seed characteristics. Length and width using digital calipers , Weight using an analytical balances , texture, color, and shape by visual inspection under a stereo microscope Viability tests were performed using the tetrazolium method. Dormancy was assessed, and scarification treatments (mechanical) were applied to evaluate germination rates. Seed germination was studied by soaking the seeds in distilled water for 24 hours and then putting these on Whatman No.1 filter paper overlain by a thin cotton layer in petri dishes. The filter

papers were moistened with distilled water and placed in a BOD at 32°C. Seed polymorphism in *Cassia tora* was evaluated by collecting seeds from the fruits of individual plants.

### Results and Discussion

*Cassia tora* exhibits seed polymorphism as seed size and shape was highly variable among the seeds obtained from a single plant (Table 1). On the basis of size, seeds of *Cassia tora* were grouped into three categories: (I) the smallest seeds (4.3 x 1.5mm) were smooth, cylindrical, brown

colour and with 0.11 g weight, (II) the medium size seeds (5.3mm x 2.5mm) were rough, cylindrical one side flat with a beak, greenish brown, hairy with 0.28 g weight, and (III) the largest seeds (6.3mm x 2.3mm) were rough, cylindrical one side flat with a small beak, dark brown, hairy and with 0.30g weight. Despite great variation in the seeds obtained from the same plant, all type of seeds exhibited seed coat dormancy and 100 percent viability and germination at room temperature in rainy season after scarification treatment.

**Table.1** Seed Morphological Characteristics of *Cassia tora* (Mean  $\pm$  SE).

Trait	Category I	Category II	Category III
Seed Length (mm)	4.33 $\pm$ 0.24	5.33 $\pm$ 0.19	6.25 $\pm$ 0.12
Seed Width (mm)	1.45 $\pm$ 0.05	2.50 $\pm$ 0.016	2.25 $\pm$ 0.22
Seed Shape	Cylindrical	Cylindrical, one side flat, prominent beak	Cylindrical, one side flat, small beak
Seed Colour	Brown	Greenish brown	Dark brown
Surface Texture	Smooth	Hairy	Hairy
Seed Weight (g)	0.11 $\pm$ 0.03	0.28 $\pm$ 0.05	0.30 $\pm$ 0.06
Dormancy type	Seed coat	Seed coat	Seed coat
Viability (%)	100	100	100
Germination After Scarification (%)	100	100	100

Seed polymorphism in *Cassia tora* reveals a sophisticated survival strategy. The three seed types may represent adaptations to microhabitat variations or staggered germination<sup>10</sup>. Larger seeds (Type III) germinated faster and produced more vigorous seedlings, offering competitive advantage in favorable conditions<sup>11-12</sup>. In contrast, smaller seeds (Type I) exhibited delayed germination and better tolerance to moisture stress, facilitating persistence in marginal habitats.

This morphological and functional diversity enables *Cassia tora* to colonize a wide ecological spectrum, explaining its success in both natural and anthropogenically disturbed landscapes such as <sup>13</sup>.

Seed polymorphism also supports staggered germination and spatial dispersion, reducing intraspecific competition and enhancing long-term survival. Similar mechanisms are observed in other invasive legumes and ruderal species<sup>14-15</sup>. Understanding seed polymorphism in invasive species like *Cassia tora* is essential for biodiversity conservation and management planning, especially in protected ecosystems.

Hairy surfaces in Category II and III likely assist in epizoochorous dispersal (seed transport via animal fur), enhancing range expansion<sup>16</sup>. Seed coat dormancy ensures delayed germination, aligning with seasonal rainfall—a critical factor in semi-arid regions. The uniform viability and germination after scarification suggest that

dormancy, rather than viability loss, limits germination. This dormancy polymorphism allows the species to hedge its bets in unpredictable climates<sup>17</sup>.

### Conclusions

Seed polymorphism in *Cassia tora* is a key ecological feature, promoting adaptability and persistence in diverse and disturbed environments. These findings not only advance our understanding of *Cassia tora*'s dominance in regions like Sariska but also provide insights into strategies for invasive species management and restoration ecology.

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