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Occasional Hermaphroditism and Plasticity in the Flowering Habit of Persian Walnut (*Juglans regia* L.)- New Report

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Short Report

Keywords: Walnut, Juglans regia L, Hermaphrodite flowers, Floral Plasticity, Dichogamy

Posted Date: March 31st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9265533/v1

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Additional Declarations: The authors declare no competing interests.

Abstract

Walnut (*Juglans regia* L.) is traditionally characterized as a monoecious plant, bearing staminate catkins on one-year-old wood and pistillate flowers on current-season growth. However, recent observations at ICAR-CITH, Srinagar, reveal significant plasticity in this bearing habit. Out of 219 bearing plants observed, instances of atypical flowering were recorded, including the development of male catkins on current-season growth and, most notably, the occurrence of hermaphrodite flowers. These hermaphrodite flowers contain both functional stamens and a receptive stigma, a phenomenon that could potentially bypass the limitations of dichogamy in commercial plantations. This report documents these rare floral transitions and suggests that environmental stressors or hormonal shifts may trigger these deviations from the standard monoecious model.

Introduction

The Persian walnut (*Juglans regia* L.) is the premier temperate nut crop in India, with primary production concentrated in Jammu & Kashmir, Himachal Pradesh, and Uttarakhand. It is successfully cultivated at altitudes ranging from 1,200 to 2,200 meters, though it has been observed at elevations exceeding 3,000 meters in the Ladakh region (Sharma et al. 2016).

As a monoecious species of the Juglandaceae family, walnuts typically separate male and female reproductive structures on the same tree. Staminate catkins are borne laterally on one-year-old branches, while pistillate inflorescences (usually 1–3 flowers) appear terminally on current-season shoots (Polito 1998). A major challenge in walnut production is dichogamy-the asynchronous maturation of male and female flowers which necessitates the interplanting of specific cultivars to ensure pollen shedding matches stigma receptivity (Polito 1998; Solar and Stampar 20011). While most Indian plantations were historically of seedling origin, the transition toward vegetative propagation highlights the need for a deeper understanding of floral biology to ensure stable yields in solid-block plantations.

Materials and Methods

Observations were conducted at the existing walnut germplasm block of ICAR-CITH, Srinagar (Latitude 33°58’58.71” to 33°59’00.16” N; Longitude 74°80’06.10” to 74°40’18.09” E; Altitude 1610m). A total of 219 bearing plants were monitored for flowering behavior. Phenological changes and atypical floral structures were recorded through critical visual inspection and photographic documentation.

Results and Discussion

While the standard bearing habit was prevalent (Fig. 1), walnut trees exhibited occasional, localized changes in their reproductive patterns. The following atypical behaviors were documented:

- Reversed Spatial Positioning: Male catkins were observed developing on current-season growth following fruit set (Fig. 2).

- Floral Reversion: In some instances, current-season growth initially produced female flowers, but subsequently converted into catkin-like structures that eventually desiccated (Fig. 3).
- Hermaphroditism: The most significant observation was the presence of hermaphrodite flowers containing both undehisced/dehisced anthers and a receptive stigma (Fig. 4).

The emergence of hermaphrodite flowers is a novel observation that opens new avenues for walnut research. If this trait can be stabilized or exploited, it could resolve the inherent difficulties of dichogamy by allowing for self-pollinating, homogamous cultivars.

These anomalies frequently occurred during late or "offseason" flowering. Such shifts in floral identity are likely linked to environmental triggers such as high temperature or moisture stress which influence internal hormonal balances. Previous studies by Hassankhah et al. (2018; 2020) support the idea that walnut flowering patterns are environmentally and genetically sensitive; for instance, GA_3 application has been shown to significantly alter the male-to-female flower ratio. At a molecular level, the transition from dormancy to flowering is governed by the activation of genes such as FT, SOC1, and LFY, while TFL1 acts as a floral inhibitor. The localized "breakdown" of monoecy observed here suggests that specific micro-climatic conditions may override standard genetic suppression, leading to the development of bisexual organs.

Declarations

Author Contribution statement

OCS conceptualized the study, developed the methodology, and conducted the primary field observations and data collection. JIM performed data curation, formal analysis, and critical manuscript review. MAS contributed to the investigation, provided photographic documentation, and assisted with technical validation. MKV provided overall supervision, facilitated resource acquisition, and performed the final editing and proofreading of the report. All authors have read and approved the final version of the manuscript for submission.

Acknowledgement

The authors are grateful to the Indian Council of Agricultural Research (ICAR), New Delhi, for providing the necessary financial support and facilities to carry out this research under the institutional programs at ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar.

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Figures

Figure 1

Normal bearing habit: (a) male catkins on previous year's growth; (b) female flowers on current season growth.

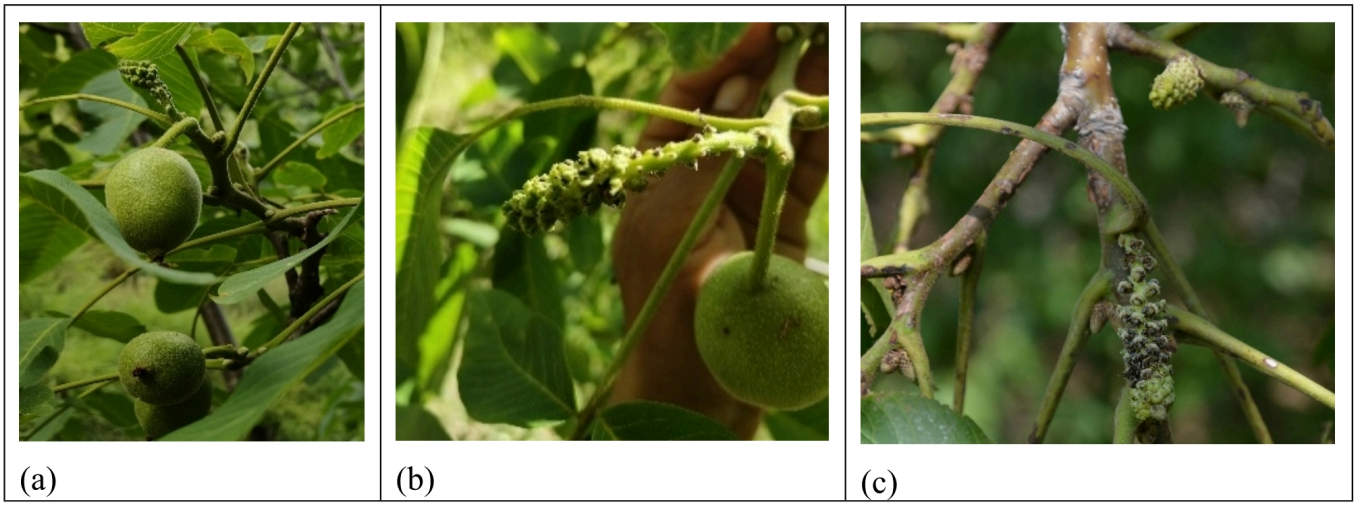

Figure 2

Atypical male catkin born on current season growth after fruit set. Catkin born on current season growth after bearing fruit (a & b) and catkin born on current season growth (c)

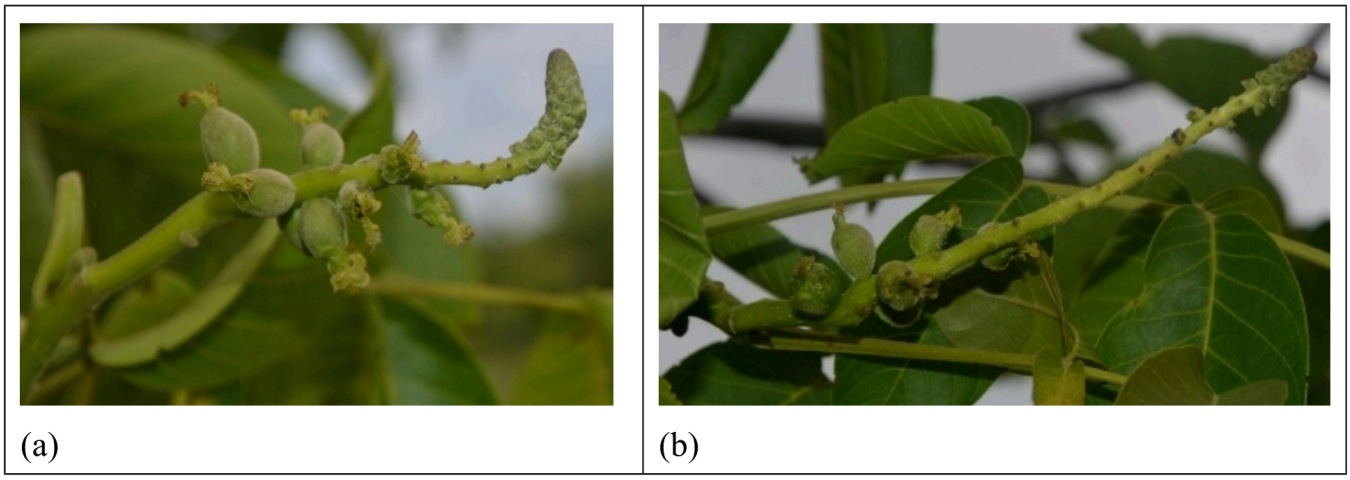

Figure 3

Current season growth showing initial female bearing (a) followed by conversion into catkin-like structures (b).

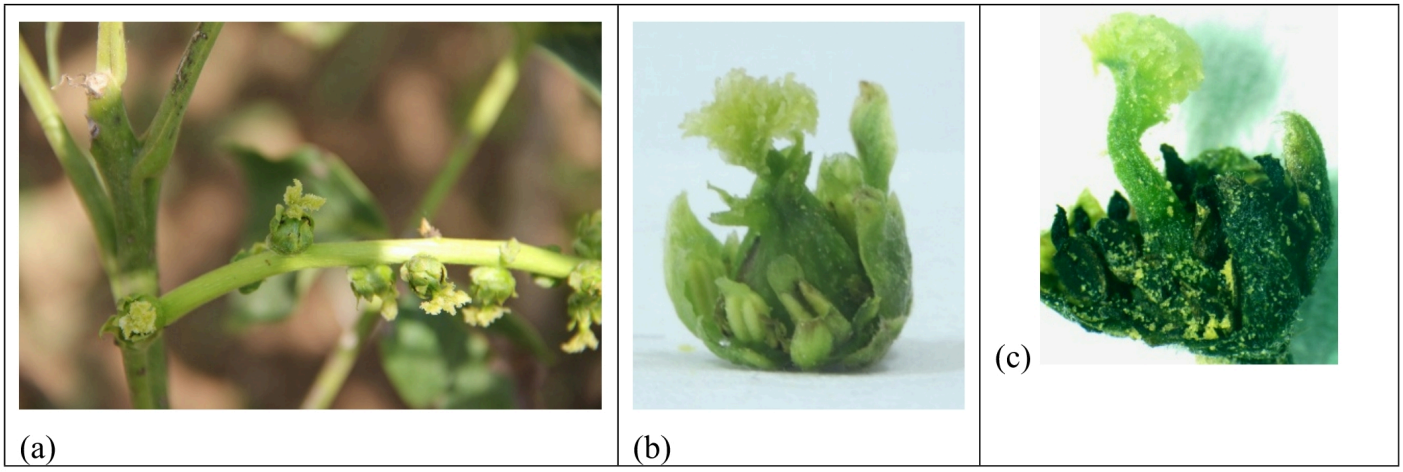

Figure 4

Hermaphroditic traits: (a) shoot with hermaphrodite flower; (b) individual flower with stigma and anthers; (c) dehisced anthers.