International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 11, Issue 10, October-2023, Available online at: www.ijaresm.com

Eggplant (Solanum Melongena L.) In Contemporary Agriculture: A Comprehensive Review

Soumyamol N[1], Sheeba M. J[2]

[1*]Research Scholar, Department of Botany, Mahatma Gandhi College, Trivandrum, Kerala, India
[2]Assistant Professor, Department of Botany, T.K.M.C.A.S, Karicode, Kollam, Kerala, India

----------**********----------

ABSTRACT

Eggplant (Solanum melongena L.), commonly known as brinjal, is a widely cultivated and economically important vegetable crop within the Solanaceae family. This research aims to present a succinct review of eggplant, drawing upon information collected from a range of readily available sources. Eggplant, a semi-spreading herbaceous plant, displays violet or white-hued, large flowers that appear singularly or in clusters of two or more in a cymose arrangement. Notably, eggplant flowers demonstrate heterostyly. This study centers on researching eggplant diversity through morphological and taxonomical analyses, foliar epidermal examinations, investigation into reproductive biology, nutritional evaluations, and economic and agricultural assessments. The findings hold importance for future references and the continued exploration of Solanaceae's invaluable vegetable, brinjal.

Keywords: Eggplant, Heterostyly, Morphology, Solanaceae

INTRODUCTION

Vegetables play an important role in our daily balanced diet by providing inexpensive sources of critical nutrients, minerals, and vitamins. Because of their health benefits, they are frequently considered as protective foods. The genetic variety available in the breeding population is critical to the success of any crop development programme. Vegetables, which are the fresh and edible sections of herbaceous plants, can be consumed raw or cooked. These edible portions include roots, stems, buds, petioles, fruits, immature blooms, and seeds. Vegetable marketing in sophisticated countries is done through highly organized and mechanized procedures. Notably, many vegetable crops are grown in rural areas rather than metropolitan ones for economic purposes. To help with the production of fresh vegetables, suitable land near houses or farm tube wells can be successfully used for vegetable cultivation. In various regions of the world, aubergine (Solanum melongena L.) is commonly known as brinjal or eggplant is a widely cultivated and economically important vegetable crop. It is a member of the Solanaceae family, which also includes major crops such as tomatoes, peppers, and potatoes. Research on eggplant diversity has encompassed morphological and taxonomical studies, foliar epidermal examinations, reproductive biology investigations, nutritional evaluations, and analyses of its economic and agricultural significance. Numerous articles were carefully examined to ensure their relevance to the study, with a selection made from those closely related to the work. Comprehensive information about the plant was acquired for this review article from a variety of sources, including journals, books, and internet pages. All collected information underwent a thorough reading and review process.

Figure 1: (a &b) Brinjal varieties

Origin and distribution

Brinjal originates from the Indo-Burma region and is widely distributed in South and Southeast Asia, Southern Europe, China, and Japan. India ranks second globally in brinjal production, yielding 83.47 lakh tonnes from 5.02 lakh ha of land. Its cultivation is prominent in Orissa, West Bengal, Bihar, and across almost all Indian states.[19].In India, West Bengal takes the lead as the primary producer of brinjal, with Maharashtra and Bihar following suit [28].

Climate, season and soil

Brinjal is categorized as a warm-season vegetable and is vulnerable to damage from severe frost. Adverse climatic conditions, particularly low temperatures during the cool season, can lead to abnormal ovary development (splitting) in flower buds, resulting in the production of deformed fruits during that period [15]. The ideal temperature range for growth and fruit set in brinjal is 20-30°C. Nonetheless, when exposed to high night and day temperatures, ranging from 22-24°C to 33-35°C, there is a significant reduction in fruit set and overall yield [11], [1], [8],[13].

While brinjal can thrive in various soil types, it performs optimally in deep, fertile, and well-drained soils, such as loam or sandy loam, particularly those enriched with organic matter. The ideal soil pH for brinjal cultivation ranges from 5.5 to 6.0 [17].

Taxonomy

Brinjal, classified within the Solanaceae family, is formally identified by its botanical name, Solanum melongena L.Based on growth habit and fruit shape, three botanical varieties are reported under S.melongena. S. melongena var. Esculentum encompasses cultivars characterized by their round and egg-shaped fruits.S. melongena var. serpentinum comprises cultivars known for their long and slender-fruited characteristics.S. melongena var. depressum comprises early and dwarf cultivars [7].

Benthem& Hooker Classification	APG IV Classification
Kingdom : Plantae Class : Magnoliopsida Sub-class : Asteridae Order : Solanales Family : Solanaceae Genus : Solanum Species : Solanum melongena L.	Domain : Eukaryota Kingdom: Plantae Clade : Angiosperms Clade : Tracheophytes Clade : Eudicots Clade : Asterids Order : Solanales Family : Solanacae Genus : Solanum Species : Solanum melongena L.

REPRODUCTIVE BIOLOGY

(a) Morphology

Eggplant is a semi-spreading, perennial or annual herbaceous plant. It has a bushy appearance and grows to a height of 60-120 cm. Large, simple, lobed, petiolate leaves with pinnatied venation. In some circumstances, trichomes and spines are hidden by leaf surfaces**.**

(b) Floral morphology

Brinjal flowers are typically large and violet in color, appearing either individually or in clusters of two or more in cymose manner. These flowers consist of several parts, including united sepals forming the calyx, five united petals forming the cup-shaped corolla, five stamens alternate with the corolla, and united carpels with a superior ovary in the gynoecium. The syncarpous, hypogynous gynoecium is positioned obliquely in relation to the median. In most varieties, perfect flowers are borne singly and are opposite the leaves. [27].

Various studies have reported that eggplant flowers exhibit heterostyly. Heterostyly is a common feature in brinjal, where four types of flowers have been identified based on the length of styles, including long-styled flowers with large ovaries, medium-styled flowers with medium-sized ovaries, and short-styled flowers with rudimentary ovaries [22], [26], [14], [12], [20], [16].

(c) Palynology

Numerous articles collectively propose a consistent and uniform morphological pattern for pollen grains within the Solanum genus. The pollen grains of Solanum species were small, prolate-shaped, and tricolporate or trizonocolporate with minute spines on exine surface. The palyno-morphological characters exhibit heterogeneous features [29], [30], [3], [10], [25], [5]. While brinjal is primarily considered a self-pollinated crop, varying degrees of cross-pollination have been documented, primarily facilitated by honey bees and bumble bees, thanks to its heteromorphic flower structure.

Variability in the percentage of long and medium-styled flowers is a varietal trait in brinjal. Fruit setting rates for long-styled flowers range from 70% to 86.7% among different varieties, while medium-styled flowers exhibit fruit set percentages ranging from 12.5% to 55.6%. Across all varieties, there is variation in style length and the positioning of the stigma relative to the stamens. Stigmas may be located above, at the same level as, or below the stamens, with the highest fruit set percentage observed when the stigma is positioned above the stamens. Short-styled flowers, on the other hand, have a fertile androecium but feature smaller stigmas with underdeveloped papillae and lower sugar content compared to long-styled flowers. In short-styled flowers, there is no pollen germination on the stigma or penetration of the pollen tube into the short styles [26].

Foliar epidermal features

In the Solanaceae family, stomata exhibit a Ranunculaceous and Cruciferous type of stomatal complex [18], [2]. Apart from the classical types of stomata, new types of stomata, including anisotricytic, paratetracytic, diacytic, and paracytic, have been observed for the first time in the Solanum genus. In particular, Solanum melongena var. insanum exhibits paracytic and anisocytic types of stomata [4]. The presence of thick leaf trichomes as a protective feature against herbivory in Solanum taxa [3].

Among the 21 species from the Solanoideae subfamily within the Solanaceae family, the foliar epidermal features were examined. All investigated species were found to have anisocytic and anomocytic types of stomata. Additionally, four types of trichomes, namely glandular, non-glandular, stellate, and dendritic, were observed. Notably, the Hyoscyamus species were distinctive in that they lacked non-glandular trichomes. The epidermal walls exhibited various characteristics, including sinuous, straight, and undulate forms [23].

Nutrional and economic importance

Brinjal (eggplant) boasts noteworthy nutritional and medicinal properties, with high fiber content, a low calorie count, and elevated levels of essential vitamins and minerals. These include significant amounts of vitamin C, potassium, and magnesium [21]. Eggplant has been identified as a rich source of essential nutrients, including dietary fiber, vitamins C and K, folate, potassium, and bioactive compounds like phenolic compounds. These components contribute to various health benefits, such as reducing the risk of chronic diseases like cardiovascular diseases, cancer, and diabetes. This is achieved through the plant's ability to exhibit antioxidant, anti-inflammatory, and antimicrobial properties [24].

Eggplant is used in the production of various processed food items like sauces, pickles, and ready-to-eat meals, adding value to the agricultural sector.In crop rotation systems, eggplant helps improve soil health by breaking pest and disease cycles, making it an essential component of sustainable agriculture.

CONCLUSION

This review has provided a comprehensive overview of eggplant (Solanum melongena L.), also known as brinjal, highlighting its significance as a widely cultivated vegetable crop in the Solanaceae family. Furthermore, our research has focused on exploring eggplant diversity through various approaches, encompassing morphological and taxonomical analyses, foliar epidermal examinations, investigation into reproductive biology, nutritional evaluations, and economic and agricultural assessments. These findings collectively contribute to our understanding of the plant's multifaceted aspects. Further investigations into the genetic diversity of eggplant could enhance our understanding of its adaptability and resilience to environmental challenges, potentially leading to improved crop management strategies. The exploration of eggplant's nutritional content and its potential health benefits could offer valuable insights for consumers and the food industry. Understanding its chemical composition and nutritional value may facilitate the development of more nutritious

and functional food products. The economic and agricultural assessments conducted in this study underscore the economic importance of eggplant cultivation.

ACKNOWLEDGEMENT

We extend our sincere gratitude to the Head of the Department, PG & Research Department of Botany, Mahatma Gandhi College, Trivandrum, Kerala, India for generously providing the necessary facilities and support for this research project

REFERENCES

[1]. A. Kumar, M.S.Dahiyaand R. D. Bhutani. (2000). Performance of brinjal genotypes in different environments of spring summer season. Haryana. Journal of Horticulture,11, 63-67
[2]. K. J. Ahmad. 1963. Cuticular studies in Solanaceae. Can. J. Bot, 24, 793-803.
[3]. G.J.Anderson and P.G.Gensel. (1976). Pollen morphology and the systematics of Solanum Section. Basarthrum. Pollen et Spores, 18: 533-552
[4]. V. S. Anil Kumar and K. Murugan. (2015). Taxonomic implications with special reference to stomatal variations in Solanum species using light and scanning electron microscope. International Journal of Applied Biology and Pharmaceutical Technology, 6(2), 112-125.
[5]. S. Ashfaq, M. Ahmad, M. Zafar, S. Sultana, S. Bahadur, S. N.Ahmed andM. Nazis. (2020). Pollen morphology of family Solanaceae and its taxonomic significance. Anaisda Academia Brasileira de Ciencias, 92(3): 1–16.https://doi.org/10.1590/0001-3765202020181221
[6]. B. K. Gupta, B.P.Mishra, Dheeraj Mishra, Amit Mishra, S.V. Dwivedi, P.K. Ojha& M.P. Singh. (2020). Adoption of recommended production technologies of brinjal in Banda district of Bundelkhand region, U.P. Journal of community mobilization and sustainable development, 15(3), 719-722.
[7]. B. Choudhary. (1976a). Vegetables (4thedn). National book trust, New Delhi. 50-58
[8]. B. K. Mohanty and A. M. Prusty. (2000). Genotype x environment interaction and stability analysis for yield and its composition in brinjal. Indain Journal of agriculture society, 70, 370-373
[9]. Biology of brinajl, Ministry of environmental and forests, Dept. of Biotechnology, Ministry of Science and Technology, Govt of Inida.
[10]. J.M.Edmonds. (1984). Pollen morphology of Solanum L. section Solanum Botanical Journal of the Linnean Society, 88: 237-251.
[11]. G.Kalloo, K.Baswana and N.K.Sharma.(1990). Heat tolerance in eggplant (Solanum melongena). Abst. 1204.XXIII. International Horticultural Congress. Florence. Italy.
[12]. R.S. Górecki and A. Espinosa-Flores. (1996). Wpływheterostyliikwiatówoberżyny Solanum melon-genaL. odm. Rodonawiązanieowocóworazliczbęnasion. Mat. Konf. Międzyn. Symp.,15–19lipiec, Skierniewice,50–51.
[13]. H. Thapa. (2002). Comparative performance of some brinjal genotypes in the summer rainy and autumn winter conditions, Msc (Hort.) thesis, pp-45. Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal.
[14]. A. K.Handique and A.Sarma. (1995). Alteration of heterostyly in Solanum melongena L. through gamma radiation and hormonal treatment. J NuclAgricBiol, 24, 121-126.
[15]. J. Nothmann and D. Koller. (1973). Morphogenetic effects of low temperature stress on flowers of eggplant. Israel Journal of Botany, 22, 231-235.
[16]. G. Kowalska. (2006). Eggplant (Solanum melongena L.) flowering & Fruiting dynamics depending on pistil type as wel as way of pollination & flower harmonization. Folia Hortic, 18(1), 17-29.
[17]. M. Lakshmi Sahithi Sri. (2022). A review on cultivation of brinjal. IJESC, 12(6). 29708-29710.
[18]. C. R. Metcalfe and L. Chalk. (1957). Anatomy of Dicotyledons. Oxford, U.K,Clarendon press, 2.
[19]. N. I. Vavilov. (1994). Origin and geography of cultivated plants (Translated by Don Love). Archives of natural history, 21(1).142-142.
[20]. H. C. Passam and A. Bolmates. (1997). The influence of style length on the fruit set, fruit size and seed content of aubergenes cultivated under high ambient temperatures. Trop. Set, 37,221-227.
[21]. V. V. Patil, S.A. Bhoiteand V.S Patil. (2012). Nutritional and medicinal properties of brinjal (Solanum melongena L.)- A review. Journal of Pharmacognosy and Phytochemistry, 1(6), 7-11.
[22]. D. N. Prasad and R. Prakash. (1968).Floralbiologyofbrinjal(Solanum melongenaL.).I.J.Agric.Sci.,38,1053–1061.
[23]. O.G. Ragab, D.G. Gabr and A.A.F. Khafagi. (2022). Micromorphological characters of the leaf epidermis for identification of certain Solanoideae (Solanaceae). IJTAR, 1(1), 38-48.
[24]. T.S. Roopashree, R. Dang, and M.P.Rani. (2013). A review on nutritional and nutraceutical properties of eggplant. Journal of Food Science and Technology, 50(4), 685-691.

[25]. D. W.Roubik and J.E.P. Moreno. (1991). Pollen and spores of Barro Colorado Island. Monographs in Systematic Botany From The Missouri Botanical Garden, 36: 146.

[26]. I. Rylski, J. Nothmann and L. Arcan. (1984). Differential fertility in short-styled eggplant flowers. Sci. Hort, 22,39-46

[27]. S.Krishnamurthy & D.Subramanian. (1954a). Some investigations on the types of flowers in brinjal (Solanum melongena L.) based on the style length and fruit set under natural conditions. Indian journal of horticulture, 11. 63-67.

[28]. S.Kumar, A. Sharma and S.K.Jha. (2016). Adoption of production technologies among jute growers in West Bengal. Journal of community mobilization and sustainable development, 12(2), 216-222.

[29]. M. L. Salgado-Labouriau, Freire de Carvalho, L.D.A. and P. Cavalcante. (1969). Pollen grains of Plants of the Cerrado XXI - Ebenaceae, Nyctaginaceae, Phamnaceae and Solanaceae. Boletim do Museu Paraense Emílio Goeldi, nova Série, Botânica, 32: 1-12.

[30]. Sharma, B.D. (1974). Contributions to the palynotaxonomy of the genus Solanum Linn. Journal of Palynology, 10: 51-68.

[31]. Van Dam, N.M. & Hare, J. D. 1998. Differences in distribution and performance of two sap sucking herbivores of glandular and non-glandular Datura wrightii. Ecol. Entomol, 23, 22-32.