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Exploring the Indian Dwarf Wheat - Triticum sphaerococcum an Ancient Hexaploid Wheat of Indian Subcontinent

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ABSTRACT

Triticum sphaerococcum **has deep historical roots in the Indian subcontinent, where it was once widely grown and considered a distinct species of wheat. The species was particularly suited to the semi-arid conditions of the north-western parts of the Indian subcontinent. This spherical grain feature likely played a role in its cultivation in regions where drought resistance and efficient water use were important. However, by the late 19th and early 20th centuries, *T. sphaerococcum* saw a significant decline in cultivation as other wheat varieties, especially the more productive, began to dominate. The spread of modern high-yielding wheat varieties, changes in agricultural practices, and the introduction of**

irrigation contributed to the replacement of Indian dwarf wheat in many regions. Though its cultivation has declined over the past century due to the rise of high-yielding modern wheat varieties, this ancient species still holds immense potential. Its drought tolerance, heat resistance, and ability to grow low input agriculture make it a key genetic resource for future wheat breeding programs, particularly in the context of climate change and the need for sustainable agricultural practices.

INTRODUCTION

Wheat is one of the world's most important staple crops, providing nearly 20% of the total calories consumed by humans globally. Its adaptability, nutritional value, and versatile applications make it a cornerstone of human civilization, contributing to the development of various societies. Among the numerous species of wheat, *T. sphaerococcum*, commonly known as Indian dwarf wheat, has a fascinating history. This article explores the characteristics, history, cultivation, ecological significance, and importance of *T. sphaerococcum* in the context of wheat biodiversity, focusing on its unique traits and relevance to India's agricultural heritage.The earliest known references to this species appear in Indian historical texts, pointing to its significance in ancient agriculture. Archaeo-botanical evidence suggests its cultivation dating back over 4,000 years (Gupta et al. 2021). The name *T. sphaerococcum* comes from the Latin words 'sphaero' (sphere) and 'coccum' (grain), referring to its characteristic round, compact grains, which differ from the elongated grains of common bread wheat (*Triticum aestivum*).

MORPHOLOGICAL CHARACTERISTICS

T. sphaerococcum is notable for its short stature and distinct morphology. Key features of this wheat species include:

- **Dwarf Nature:** One of the most defining characteristics of *T. sphaerococcum* is its short, dwarf-like structure. The plant grows to a height of approximately 50 to 90 cm, which is considerably shorter than common wheat varieties.
- **Round Grains:** As the name suggests, the grains are spherical or nearly round. This is one of the key distinguishing features of the species. The grains are smaller and more compact than those of common wheat, which is generally elongated.
- **Compact Spikes:** The ears or spikes of *T. sphaerococcum* are compact and closely packed, often appearing denser than those of other wheat varieties.
- **High tillering:** The plant has high number of tillers; however, all are not productive. This resilience was advantageous in regions prone to extreme drought conditions.
- **Growth Cycle:** Indian dwarf wheat has a relatively longer growing season, typically maturing in about 120 to 160 days depending on the environmental conditions and accessions.

AGRONOMIC AND ECOLOGICAL ADAPTATION

T. sphaerococcum was well-adapted to the arid and semi-arid environments of the Indian subcontinent, where other crops struggled to survive. Its robust nature and adaptability to specific ecological conditions allowed it to thrive in regions with limited water supply and challenging soil conditions. Its cultivation was traditionally concentrated in areas of present-day Pakistan, Rajasthan, Gujarat, and parts of northern India.

Drought Tolerance: One of the species' most valuable traits was its ability to tolerate drought. The compact growth form, thick stalks, and spherical grain structure may have contributed to its resilience in water-limited environments. While common wheat required more consistent rainfall or irrigation, *T. sphaerococcum* could withstand periods of water scarcity (Gaikwad et al., 2024).

Heat Tolerance: Indian dwarf wheat exhibited greater heat tolerance compared to other wheat species. This was an essential feature for regions experiencing hot, dry conditions during the growing season. While excessive heat can negatively impact the yield of many wheat varieties, *T. sphaerococcum* showed resilience in such climates (Gaikwad et al., 2024).

Soil Adaptability: The species was often grown in soils with lower fertility, making it a valuable crop for farmers in regions with poor soil quality. While other wheat varieties required more nutrient-rich soils or regular fertilization, *T. sphaerococcum* could be grown with minimal inputs, which was advantageous for subsistence farmers.

DECLINE IN CULTIVATION

Despite its beneficial agronomic traits, *T. sphaerococcum* began to fall out of favor as new wheat varieties, particularly *Triticum aestivum* (bread wheat) and *Triticum durum* (durum wheat), gained prominence. Several factors contributed to the decline of Indian dwarf wheat:

1. Introduction of High-Yielding Varieties: In the mid-20th century, the green revolution brought new, high-yielding wheat varieties that were more productive than traditional species. These modern wheat strains, such as those developed by Nobel laureate Norman Borlaug, were introduced into India as part of efforts to increase food security. They produced significantly higher yields under irrigated conditions and were more suited to modern agricultural practices, such as the use of chemical fertilizers and mechanized farming.

2. Irrigation and Fertilizer Use: The expansion of irrigation systems and the widespread use of chemical fertilizers during the Green Revolution further reduced the need for drought-tolerant and low-input varieties like *T. sphaerococcum*. Farmers shifted towards varieties that performed better under intensive, resource-rich cultivation conditions.

3. Market Demands: Consumer preferences and market demands also influenced the decline of Indian dwarf wheat. *Triticum aestivum*, which is used to make bread and a wide variety of processed wheat products, became the dominant wheat species because it met the needs of expanding urban markets. The small, spherical grains of *T. sphaerococcum* were less desirable for large-scale flour production.

4. Conservation Challenges: As *T. sphaerococcum* cultivation dwindled, the genetic diversity it represented also diminished. Farmers began to abandon traditional landraces in favor of high-yielding varieties, resulting in the erosion of local crop biodiversity. Conservation of traditional wheat species became a low priority in the face of efforts to boost wheat production to feed a growing population.

GENETIC DIVERSITY AND BREEDING POTENTIAL

The genetic diversity of wheat is crucial for ensuring the long-term resilience of global food systems. Landraces and wild relatives of wheat, such as *T. sphaerococcum*, harbor valuable

genetic traits that may be useful in breeding programs aimed at improving modern wheat varieties. These traits include drought tolerance, heat resistance, and better nutritional quality-factors that are increasingly important as climate change impacts agriculture worldwide. Although *T. sphaerococcum* has largely disappeared from commercial cultivation, it remains an important genetic resource. Very few farmers in the Indian states of Rajasthan, Madhya Pradesh, Gujrat and Maharashtra are growing this wheat however, they possibly have same cultivar. Researchers and plant breeders continue to explore the potential of this species for use in breeding programs, particularly in efforts to develop wheat varieties that are better suited to challenging environmental conditions.

Donors for abiotic stress tolerance: Given the increasing frequency of droughts and heat waves caused by climate change, the traits of *T. sphaerococcum* may become essential in future wheat breeding efforts. Crossbreeding with modern wheat varieties could help improve resilience in water-scarce and heat-prone regions. Tolerance of this species to terminal heat and drought have been assessed in recent study (Gaikwad et al., 2024).

Adaptation to organic farming: This species is known to have better performance under low-input agriculture. In a study conducted by Szczepanek et al., (2020) it was seen that *T. sphaerococcum* performed better under organic agriculture. This aligns with efforts to promote more sustainable and environmentally friendly agricultural practices.

Preservation of Biodiversity: Preserving the genetic diversity of wheat is critical for maintaining the ability to respond to future agricultural challenges. Conserving traditional wheat species like *T. sphaerococcum* can help safeguard the genetic base of wheat crops against unforeseen threats, such as the emergence of new pathogens or changes in climate.

EFFORTS IN CONSERVATION

The recognition of the importance of biodiversity in agriculture has led to efforts to conserve traditional wheat varieties and their wild relatives. Various initiatives, both governmental and non-governmental, aim to protect the genetic heritage of *T. sphaerococcum* and other wheat species through seed banks, field collections, and on-farm conservation practices.

Gene Banks: Institutions such as the ICAR- National Bureau of Plant Genetic Resources (NBPGR) and international organizations like the Consultative Group on International Agricultural Research (CGIAR) maintain collections of wheat germplasm, including *T. sphaerococcum*, in gene banks. These seed banks play a critical role in preserving the genetic material of wheat varieties that are no longer widely cultivated.

On-Farm Conservation: In some regions, traditional farming communities continue to grow landraces of wheat, including *T. sphaerococcum*, as part of their agricultural heritage. These practices not only help preserve biodiversity but also provide a living repository of traditional knowledge about the cultivation and use of these crops.

Research Institutes: Scientists and plant breeders continue to study *T. sphaerococcum* and other traditional wheat species to identify traits that could be useful in modern agriculture.

Advances in genomic technologies have made it easier to explore the genetic diversity of wheat and to incorporate beneficial traits into new varieties through breeding programs.

CONCLUSION

T. sphaerococcum, or Indian dwarf wheat, represents a valuable part of India's agricultural heritage. The conservation of *T. sphaerococcum* and other traditional wheat varieties is essential to safeguarding the genetic diversity of wheat, ensuring food security, and enabling farmers to meet the challenges of a changing environment. In an era where global agriculture faces unprecedented pressures, the lessons from the past and the genetic resources of ancient crops like Indian dwarf wheat may hold the key to a more resilient future.

REFERENCES

Gaikwad, K. B., Dawar, A., Singh, A., Babu, P., Kumar, M., Kumar, N., ... & Yadav, R. (2024). Trait phenotyping in an ancient Indian landrace of wheat *T. sphaerococcum* under optimum, terminal heat stress and deficit irrigation conditions. *Genetic Resources and Crop Evolution, 71*(6), 2779-2795.

Gupta, A., Hua, L., Lin, G., Molnár, I., Doležel, J., Liu, S., & Li, W. (2021). Multiple origins of Indian dwarf wheat by mutations targeting the TREE domain of a GSK3-like kinase for drought tolerance, phosphate uptake, and grain quality. *Theoretical and Applied Genetics, 134*, 633-645.

Mori, N., Ohta, S., Chiba, H., Takagi, T., Niimi, Y., Shinde, V., ... & Osada, T. (2013). Rediscovery of Indian dwarf wheat (*Triticum aestivum* L. ssp. *sphaerococcum* (Perc.) MK.) an ancient crop of the Indian subcontinent. *Genetic Resources and Crop Evolution, 60*, 1771-1775.

Szczepanek, M., Lemańczyk, G., Lamparski, R., Wilczewski, E., Graczyk, R., Nowak, R., & Prus, P. (2020). Ancient wheat species (*T. sphaerococcum* Perc. and *T. persicum* Vav.) in organic farming: Influence of sowing density on agronomic traits, pests and diseases occurrence, and weed infestation. *Agriculture, 10*(11), 556.