Forgotten Grains: The Future of Food Security in a Heating World

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ABSTRACT

As we stand on the precipice of 2026, the “Green Revolution” legacy of rice and wheat is facing its toughest test: a heating planet. While the world celebrated the 'Year of Millets' in 2023, a quieter, more urgent revolution is brewing in the margins of Indian agriculture. The Year 2025 has marked a pivotal shift in Indian agriculture, moving from “Calorie Security” to “Nutritional and Climate Security”. Beyond the “Big Three” cereals and even beyond the popular millets, lies a treasure trove of “forgotten grains”-crops like Amaranth, Buckwheat, Teff and Job's Tears. These are not just biological curiosities; they are agronomic powerhouses capable of thriving where modern hybrids fail. For us as young agronomists, the mission is clear: we must reintegrate these ancient grains to secure a climate-resilient future.

INTRODUCTION: The “Resilient Revolution”

The narrative of Indian agriculture is changing. While the release of 109 climate -resilient varieties by the prime minister Narendra Modi in august 2024 was a land mark movement, the challenge remains vast. The Indo-Gangetic plains are battling heat stress, and the deccan plateau faces erratic monsoons. In this context, the “Big Three” - rice, wheat and maize are becoming increasingly resource-intensive and risky.

Enter the "Forgotten Grains." These are not merely survival foods for the poor; they are agronomic marvels that have evolved over

millennia to thrive in sub-optimal conditions. Unlike modern hybrids bred for input responsiveness, these crops are bred for survival. For the modern agronomist, they offer a unique toolkit: C4 photosynthetic pathways (in Amaranth and Job's Tears) that minimize photorespiration under heat, and deep rooting systems (in Teff and Buckwheat) that mine sub-soil moisture.

Description: A split-panel infographic. On the left, a "Thermal Image" of a wheat field showing high canopy temperature (stress). On the right, a cool, blue-spectrum canopy of an Amaranth field under the same ambient temperature, illustrating its superior transpiration efficiency.

Fig 1. Physiological Resilience: Amaranth maintains cooler canopy temperatures during heatwaves compared to C3 cereals, preserving grain filling rates.

The Pseudo-Cereals: Amaranth and Buckwheat

Often grouped together as "fasting foods" (Vrat ka Khana), these two crops represent two distinct physiological strategies for climate adaptation.

Amaranth (*Amaranthus spp.*): The C4 Powerhouse

Amaranth is a classic C4 plant, meaning it concentrates CO_2 around the enzyme RuBisCO, virtually eliminating photorespiration. This makes it incredibly water-efficient.

- **Recent Agronomic Trials (2025):** A study conducted at the Naini Agricultural Institute, Prayagraj, evaluated eight varieties and found that 'Arun Red' consistently outperformed others, recording maximum plant height and leaf biomass. The variety demonstrated a unique ability to maintain turgor pressure even at 45 Days After Sowing (DAS) during dry spells (Kesav *et al.,* 2025).
- **Yield Potential:** While traditional varieties yield 10-12 q/ha, improved cultivars like 'Durga' and 'BGA-2' have shown potential up to 25-40 q/ha in the hill regions of Gujarat and Uttarakhand.
- **Agronomic Tip:** For seed production, a spacing of 45 x 15 cm is optimal. However, for leafy biomass (vegetable use), closer spacing of 20 x 10 cm significantly increases the Leaf Area Index (LAI) without compromising quality.

Buckwheat (*Fagopyrum esculentum*): The Short-Duration Saviour

Buckwheat is a C3 plant but compensates with a rapid life cycle (70-90 days) and high "plasticity."

- **Drought Mechanisms:** Recent high-throughput phenotyping of Buckwheat genotypes (e.g., 'Panda') under water stress revealed a re-allocation of assimilated carbon. Instead of stalling growth, the plant rapidly accumulates anthocyanins and carotenoids to protect chlorophyll from oxidative damage (Antala *et al*., 2025).
- **Nutritional Advantage:** Unlike rice, which is devoid of Vitamin B2 (Riboflavin), Buckwheat is three times richer in B2 and contains Rutin, a flavonoid crucial for maintaining blood vessel elasticity.
- **Leh-Ladakh Success:** In the cold arid desert of Ladakh, where wheat fails due to the short growing season, Buckwheat genotypes have shown stable yields, proving it to be the ultimate "niche" crop for extreme altitudes (Saxena *et al*., 2025).

Job's Tears (*Coix lacryma-jobi*): The Wetland Warrior

While most climate-resilient crops are for drylands, Job's Tears (locally Gara Bheeda or

Adlay) is the answer for water-logged areas where rice methane emissions are a concern.

- **Morphology & Habit:** Unlike the hollow stems of paddy, Job's Tears has a solid, pithy stem that resists lodging—a common problem in heavy rainfall zones of the Northeast.
- **Yield Optimization:** A 2025 investigation in Nagaland identified the JBN-10 line as a superior genotype, yielding up to 887 kg/ha with minimal inputs. The study highlighted that simple agronomic interventions - specifically three split tillages to control weeds - can double the yield compared to traditional broadcasting (Kumar *et al.,* 2017).
- **The "Super-Grain" Profile:** It looks like pearl barley but outperforms rice in every nutritional metric. It contains significantly higher Lysine and Threonine (essential amino acids often limiting in vegetarian diets) and possesses unique bioactive compounds like Coixenolide, known for its anti-tumor properties.

Description: A high-resolution cross-section micrograph of a Job's Tears grain alongside a Rice grain. The Job's Tears grain shows a larger, denser endosperm and a thicker aleurone layer (protein-rich).

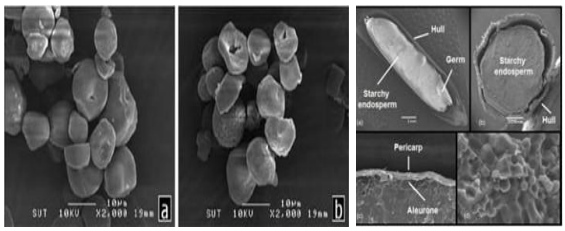

Fig 2. Nutritional Density: The thick aleurone layer of Job's Tears accounts for its superior protein content (13-14%) compared to polished rice (6-7%).

Teff (*Eragrostis tef*): The Dryland Novelty

Originating from the Horn of Africa, Teff is the smallest grain in the world (1/150th the size of wheat) but is making a massive impact in Indian dryland trials, particularly in Karnataka.

- **The Agronomic Breakthrough (2025):** The biggest challenge with Teff has been lodging due to its thin stem. However, recent trials have standardized a "Transplanting Technique." Instead of broadcasting, transplanting 25-day-old Teff seedlings resulted in an 18.59% increase in grain yield compared to traditional broadcasting. This method encourages better root anchorage and reduces inter-plant competition.
- **Fertilizer Response:** Contrary to the belief that orphan crops need "zero input," Teff responds significantly to balanced nutrition. Application of 80:80 kg N:P per hectare has been shown to maximize biomass, making it an excellent dual-purpose crop (grain + high-quality fodder) for dairy farmers.
- **Nutritional Gold:** Teff is calcium-rich (180mg/100g) compared to wheat (33mg/100g), making it a potential remedy for calcium deficiency in rural Indian populations.

CONCLUSION: From Orphan to Opportunity

The term "Orphan Crops" is a misnomer; these crops have not been abandoned by nature, only by policy. As the data from 2024-25 clearly shows, crops like Amaranth, Buckwheat, Job's Tears, and Teff possess the genetic machinery to withstand the abiotic stresses that are decimating commercial hybrids. For the Farmers, the future lies in **System Diversification**. We do not need to replace rice or wheat entirely; we need to introduce these forgotten grains into crop rotations-using Buckwheat as a catch crop after potato, growing Job's Tears in water-stagnated pockets, or intercropping Amaranth with pulses. By doing so, we secure not just the farm's economy, but the nation's health. The future of food security is ancient, and it is waiting to be rediscovered.

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