

Millets: Resiliency towards Climate Change

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Abstract

The world is experiencing an unprecedented increase in extreme weather conditions and India is not an exception. Increasing temperatures, changing monsoon and more frequent extreme climate events are posing a threat to food security in India. In this context, millets are most useful as it is a nutritious, climate change-ready crop with enormous potential for yielding higher economic returns in marginal conditions. Millets being a climate-resilient crop are important to minimize the adverse effects of climate change and has the potential to increase income and food security of farming communities.

Introduction

Climate change as well as growing population has led to antagonism over resources such as water and soil, thereby adversely affecting food systems and crop productivity, especially the major cereals such as rice, wheat and maize but millets have the potential to help humans in dealing with climate change and poverty, millets have high photosynthetic efficiency with an excellent productivity and growth in low nutrient soil conditions and is less reliant on chemical fertilizers. It is more resilient to extreme climatic events such as drought and water scarcity and can play a vital role in ensuring food and nutritional security in changing climatic scenarios. It also possesses several advantages such as early maturity, drought tolerance, the requirement of minimal inputs, and usually free from biotic and abiotic stresses, therefore making them “famine reserves”. The UNGA adopted a resolution declaring 2023 as the ‘International Year of Millets’.



Role of Millets in Human Health

Millet has an excellent nutritional profile and is a non-glutinous food. This makes them easily digestible and non-allergenic foods.

✓ ***Regulate Blood Glucose Levels***

Compared to wheat and maize, millets are rich in phosphorus, potassium, iron and magnesium and have a low glycaemic index of 54-68. Presence of a high amount of dietary fibre, proteins and minerals helps in stabilizing the blood sugar levels.

✓ ***Good For Heart***

Studies show that millet can also raise your “good” cholesterol levels and lower triglycerides. Millets include beta-glucans, flavonoids, anthocyanidins, tannins, lignans, and policosanols. These antioxidants play a crucial role in lowering LDL cholesterol.

✓ ***Help In Weight Loss***

Millets are a boon for all weight watchers who are wanting to shed those extra kilos. Including millets in the regular regimen like millet flour or having millets for breakfast can remarkably help in lowering the BMI of obese people.

✓ ***Battles Cancer Cells***

The phytochemicals in millets exhibit antiproliferative effects and lower formation of cancer cells in the colon, breast, and liver without causing any damages to normal cells.

✓ ***Promotes Digestion***

The presence of a good amount of dietary fibre in millets works well to improve the digestive system function. It combats constipation, flatulence, bloating, cramping, regularizes the bowel function and improves the overall health and boosts the immune system.

Traits Contributing Climate-Resilience to Millets

The changing climate is leading to an increase in global average temperature affecting agricultural production worldwide. Further, it directly influences biophysical factors such as plant and animal growth along with the different areas associated with food processing and distribution. In the present-changing climatic scenario, abiotic stresses entail a huge risk for

plant growth and development leading to an over 50% decrease in the yield among the popular cereal crops.

- ✓ **Withstand the climatic vagaries:** Rice yields, compared to all the coarse grains are more sensitive to fluctuations in climatic vagaries. In this context, a crop species like millet is resilient to higher temperatures and lower rainfall, can play a crucial role in fulfilling the increasing food demands.
- ✓ **Marginal cultivation:** Millets are mainly cultivated on marginal lands facing untimely and irregular rainfall patterns and environmental stresses due to its natural inbuilt capacity to survive in such areas and withstand abiotic stresses such as drought, salinity, heat etc.
- ✓ **Food security:** Millets possess immense potential in our battles against climate change and poverty, and provide food, nutrition, fodder and livelihood security.
- ✓ **Low carbon footprint:** Millets are also helpful for mitigating the effects of climate change through their low carbon footprint of 3t equivalent of carbon dioxide per hectare, as compared to wheat and rice, with 3.9t and 3.4t, respectively.
- ✓ **Ephemeral in nature:** Primarily, the short life-cycle of millets assists in escaping from stress as they require 6-10 weeks to complete their life-cycle (seed to seed) whereas rice and wheat requires a maximum of 20–24 weeks.
- ✓ **Physiological traits:** Due to the high affinity of the CO₂ by RUBISCO, C₄ mechanism enhances the CO₂ concentration around the bundle sheath, which suppresses photorespiration (around 80%) depending on the temperature.
- ✓ **C-4 crop:** Millets have enhanced photosynthetic rates at warm conditions and confers immediate water use efficiency (WUE) and nitrogen use efficiency (NUE) which are ~1.5 to 4-fold higher than C₃ photosynthesis.
- ✓ **Secondary benefit:** In addition to conferring WUE and NUE, C₄ photosynthesis provides secondary benefit to millets including improved growth and ecological enactment in warm temperatures, enhanced flexible allocation patterns of biomass and reduced hydraulic conductivity per unit leaf area

These attributes of millets make them next-generation crops holding the potential for research to explore the climate-resilient traits and exploit the information for the improvement of major cereals.

Global Warming Potential of Millets



Among all the major cereal crops, wheat has the highest global warming potential of around 4 tons CO₂ eq ha⁻¹ followed by rice and maize (around 3.4 tons CO₂ eq ha⁻¹). These crops also have a high carbon equivalent emission (CEE) of 1000, 956 and 935 kg C ha⁻¹ for wheat, rice and maize, despite their higher emission rates, they are widely cultivated. However, millets have the lowest GWP with 3.2t CO₂ eq. ha⁻¹. The carbon equivalent emission (CEE) of millets have the lowest carbon emissions (878 kg C ha⁻¹).

Conclusion

This year, the United Nations General Assembly adopted a resolution declaring 2023 the International Year of Millets, as proposed by India to the Food and Agriculture Organization (FAO). Millets possess immense potential in our battles against climate change and poverty, and provide food, nutrition, fodder and livelihood security. These features accentuate millets as crops of choice for the world population amid growing concerns about climate change.