Ecofarming
e-Magazine for Agriculture and Allied Sciences
http://www.ecofarming.rdagriculture.in
e-ISSN: 2583-0791

Pearl Millet Cultivation

A Sustainable Approach to Climate Change Mitigation

1. **Alok Sinha**
Division of Agronomy, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012, India
Email: aloksinha2304@gmail.com
2. **Neelkamal Mishra**
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, India
3. **Sunil Kumar Prajapati**
Division of Agronomy, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012, India

Received: February, 2024; Accepted: March, 2024; Published: April, 2024

Abstract

The escalating global population necessitates a constant supply of food, leading to resource conflicts exacerbated by climate change. This phenomenon poses significant challenges to food systems, particularly for staple cereals like maize, wheat, and rice. Addressing these challenges requires innovative approaches that mitigate climate impacts while ensuring food security. This paper explores the potential of pearl millet (bajra) cultivation as a sustainable solution. Pearl millet exhibits remarkable resilience, thriving in adverse conditions such as poor soils and limited irrigation. Its cultivation offers a promising alternative in combating climate change-induced food insecurity. Compared to major cereal crops like wheat, maize, and rice, pearl millet has a lower carbon footprint and higher adaptability to arid environments. Its xerophilic and thermophilic nature makes it suitable for cultivation in semi-arid and dry regions. The cultivation package for pearl millet includes land preparation, seed selection, treatment, sowing methods, and nutrient management tailored to diverse agro-climatic zones. Effective weed and pest management strategies contribute to successful cultivation. Additionally, crop rotation and the use of resistant cultivars mitigate disease risks. Pearl millet's nutritional profile, including its low glycemic index and high protein, fibre, and mineral content, underscores its potential in addressing malnutrition and diet-related illnesses. Its cultivation aligns with the imperative of crop diversification to enhance food security in the face of climate uncertainty.

Introduction

An expanding population results in a constant need for food. Antagonism over resources like water and soil has resulted from this worldwide concern. The quality and availability of these resources can be directly impacted by climate change, which can have a negative impact on crop productivity and our food systems, particularly for important cereals like maize, wheat, and rice. Two of the most important issues facing the modern world are feeding the globe's population and combating hunger. This problem is caused by a variety of factors, including insufficient intake of micro- and macronutrients, a lack of food production, which results in imbalances in supply and demand, and conflicts that cause instability in different regions of the world. The threat of climate change and global warming persists

even though several of these hunger triggers can be addressed, resulting in a minor decrease in the population suffering from hunger and malnutrition from about one billion in 1990–1992 to 850 million in 2010–2012. An estimated 2-3 billion people may experience food insecurity and hunger by 2050 as a result of declining food production rates and the additional burden of feeding a population expected to surpass 9 billion. A direct correlation has been observed between climate change and rising world average temperatures and crop yields, crop productivity, and the sustainability of our food systems as a whole. Climate change may help a few locations due to improved yields and productivity, according to some estimates, but this will not be enough to feed the world's growing population. Moreover, the majority of scientists concur that the current rates of greenhouse gas emissions and global warming would drastically lower crop output overall. Thus, attaining food security depends critically on lowering greenhouse gas emissions to regulate global temperatures. But one of the main industries releasing greenhouse gases into the environment, including methane, is agriculture. Intensive agricultural practices, which are employed in many parts of the world, are typically the cause of higher emissions. Since Pearl millet has inherent ability to grow in unfavourable environments like poor soils and sparse irrigation, it has been considered as a grain substitute.

Climate Mitigation Ability of Pearl millet

Cereal crops have a substantial potential to contribute to global warming in addition to being a key supply of macronutrients including proteins, lipids, and carbohydrates (Saxena *et al*., 2018). Of all the major cereal crops, wheat has the greatest potential to cause global warming (about 4 tonnes CO2 equivalent per hectare), followed by maize (about 3.4 tonnes CO2 equivalent per hectare) and rice. Moreover, the carbon equivalent emissions of these crops are high—1000, 956, and 935 kg C/ha for wheat, rice, and maize, respectively. They are extensively grown and the world's main source of sustenance, while having higher emission rates. Other minor cereal crops, such sorghum and millets, have relatively smaller carbon footprints. This is one of the main explanations for why millets may be a crop that helps the world's carbon footprint shrink. The most widely grown millet varieties worldwide, according to the FAO (2014), are Pearl, Proso, Foxtail, Japanese Barnyard, Finger, and Kodo. Distinct varieties of millets are known by distinct scientific names and by popular names depending on the area in which they are grown. These millets are grown in various parts of the world and have varying growth conditions. Billions of people worldwide rely on rice, wheat, maize and to a lesser degree millet as their main sources of nourishment on a daily basis. These crops' growth patterns are determined by temperature and the availability of water. While wheat is mostly cultivated in regions with adequate temperatures and minimal water resources, rice and maize are grown in locations with an abundance of water. There are few water resources in the locations where millets and sorghum are farmed. Furthermore, due to their resilience to biotic and abiotic challenges and their ability to produce a sizable yield on poor quality soil with little input, millets can be grown in semi-arid and dry environments. Millets are often xerophilic-capable of reproducing with little water input and thermophilic-thriving at comparatively warmer temperatures. Since pearl millet uses moisture more effectively than sorghum or maize, it can thrive on poor sandy soils and is a good choice for arid conditions. Therefore, pearl millets are typically planted in regions with marginal soil and 200–500 mm of annual rainfall. Pearl millet is the sixth most significant crop farmed globally, according to the FAO (2014). A traditional crop in India, Pakistan, the Sahel region of Western Africa, Central, Eastern, and Southern Africa, as well as along the southern coast of the Arabian Peninsula, is pearl millet.

Package and Practice of Pearl millet Cultivation

Land Preparation: It grows poorly in soils that are prone to flooding. To develop fine tilth, the land should be ploughed once or twice and then harrowed.

Seed Selection: The hybrids are mostly grown but varieties of bajra limited to drought prone area. Below is the most recent list of pearl millet hybrids and varieties.

Region/ State	Season	Recommended Hybrid	Recommended Variety
Rajasthan, Gujarat, Haryana, Punjab, Delhi, Uttar Pradesh, Madhya Pradesh	Kharif	KBH 108, GHB 905, 86M89, MPMH 17, Kaveri Super Boss, Bio 448, MP 7872, MP 7792, 86M86, 86M66, RHB-173	MBC 2, PC 443, JBV 3, PC 383
Maharashtra, Tamilnadu, Andhra Pradesh, Karnataka	Kharif	Kaveri Super Boss, Pratap, Shine, MP 7792, 86M86, PAC 909, 86M64, 86M53	PC 612, CoCu 9, Samrudhi, ICMV 221, Raj 171, ICMV 155

Seed treatment: To prevent soilborne diseases, apply seeds with biopesticides (Trichoderma harzianum @ 4 g kg-1 or thiram 75% dust @ 3 g kg-1). Smut disease is controlled by treating seeds with 300-mesh sulphur powder at a rate of 4 g kg-1. The seeds that have been impacted by ergot are steeped in a 10% salt solution. Downy mildew is controlled by treating seeds with metalaxyl (Apron 35 SD) at a rate of 6 g kg-1. To increase the availability of nitrogen and phosphorus in seeds, 600 g of Azospirillum and 600 g of Phosphobacterium are applied.

Method of sowing: Three methods are used to sow pearl millet: Using a broad-bed and furrow system, ridge and furrow system and on a flat surface the recommended seed depth is between 2.5 and 3 cm.

Time of sowing: In the north and central regions of the nation, the first two weeks of July mark the start of the monsoon season, which is when kharif pearl millet should be sown. In Tamil Nadu, the first two weeks of October are when the Rabi season begins. If there is a sparse population, fill the gap by transplanting seedlings two to three weeks after sowing. It is advised to sow dry seeds in the Marathwada region of Maharashtra before the onset of the monsoon season. In order to increase summer pearl millet yield, it is recommended to sow the crop between the fourth and fifth Standard Meteorological Weeks (SMW), or the final week of January and the first week of February.

Seed rate, Spacing and Plant population: Pearl millet should be sown in rows 60 centimetres apart in the arid-western plain of Rajasthan, Haryana, and Kutch, Gujarat (A1 zone), with a low plant population of 1.00 to 1.25 lac/ha. Regions, which receive more than 450 mm of rainfall annually, should plant crops with a 45 x 10-15 cm spacing, maintaining a plant population of 1.75 to 2.0 lakhs/ha. For the crop, the recommended seed rate is 3 to 4 kg/ha in order to achieve the necessary plant stand.

Irrigation: If water is available, irrigation should be applied during important periods of crop growth, such as tillering, flowering, and grain formation, during extended dry spells. Pearl millet needs to be watered in the summer at regular intervals (0.75-1.0 IW/CPE with 40 mm), according on the crops needs.

Nutrient Management: For both solo pearl millet and intercropping systems, application of 40 kg N + 20 kg P2O5/ha for arid regions and 60 kg N/ha + 30 kg P2O5/ha for semi-arid regions is advised. The applied nitrogen may leak with heavy rainfall in light soils (sandy loams). Therefore, when preparing a seedbed, just roughly half of the recommended nitrogen dose should be applied. When the crop is 25 days old, the remaining half of the nitrogen dose is applied as a side dressing. If the soil is not as permeable as black soil, then all of the nitrogen can be added when preparing the seedbed. Fertiliser burn can affect pearl millet seeds. After sowing, avoid adding fertiliser in

the row right next to the seed or in the furrow where the seed is located. Applying it as a side dressing is appropriate. The application of N and P fertiliser can be reduced by using bio-fertilizer (Azospirillum and PSB). The country's pearl millet growing region's zinc-deficient soils should be treated with 10 kg ZnSO4/ha. It is advised to apply a 0.2% ZnSO4 spray during tillering to the pre-flowering stage of the crop in order to address the zinc shortage. Spray 2% urea and forgo the top treatment of N during a protracted dry spell. During the vegetative period, an extra dose of nitrogen at a rate of 20 kg/ha should be administered when there is considerable rainfall.

Weed Management: Effective weed control can be achieved with just two hoeing and weeding at 15 and 30 DAS, which is similar to herbicidal weed control achieved with pre-emergent atrazine application of 0.5 kg/ha followed by one-hand weeding. Removing the second weed aids in preserving soil moisture.

Cropping System: Cultivar rotation should be used as well, to prevent the downy mildew disease issue. It is best to employ open-pollinated types and hybrids of pearl millet in different seasons and years. It is not advisable to keep growing the same open-pollinated or hybrid variety on the same plot of field.

Harvesting: When the plants reach physiological maturity, indicated by the black spot at the bottom of the grain in the hilar region, which is the ideal time to harvest pearl millet. The leaves of the crop become yellowish and almost completely dry as it ages. The grain is solid and hard. When harvesting pearl millet, the ear heads are often cut first, followed by the stalks. After a week, the stalks (straw) are trimmed, let dry, and then stacked. A grain is deemed dry if its moisture content is 14% or below. Grain moisture level should be less than 12% for long-term storage (greater than 6 months).

Insect Pests management: In most of India's pearl millet-growing regions, insect pests are regarded as comparatively less significant. The white grub, shoot fly, and grey weevil are the three insect pests that affect pearl millet the most.

Diseases management: Pearl millet in India has been linked to over 50 diseases due to various biotic variables, however only a small number of these are significant. These include blast, rust, ergot, smut, and downy mildew. These illnesses impact grain formation, which directly lowers grain production. Ergot can also lower the quality of grains. The most economical way to manage diseases that affect pearl millet is to use resistant cultivars.

Conclusion

In order to feed the world's population, which is expected to increase at an accelerated rate-8.5 billion people by 2030 and 9.7 billion by 2050-more food must be produced. Crop diversification-promoting crops that can be grown in the toughest environments-is urgently needed in light of the worsening climate crisis and mounting environmental stress. Millets have a low glycemic index, which may help prevent or control diabetes. They are also high in protein, fibre, and resistant starch. Rich in vitamins and minerals, including calcium and iron.

References

1. Food and Agriculture Organization of the United Nations (2012). Technical Note: FAO Methodology to Estimate the Prevalence of Undernourishment; FAO: Rome, Italy.
2. Khairwal, I. S., Rai, K. N., Diwakar, B., Sharma, Y. K., Rajpurohit, B. S., Nirwan, B., and Bhattacharjee, R. (2007). Pearl millet crop management and seed production manual. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India.
3. Saxena, R., Vanga, S. K., Wang, J., Orsat, V., and Raghavan, V. (2018). Millets for food security in the context of climate change: A review. *Sustainability,* 10(7), 2228.