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Pearl Millet: A Befitting Crop for the Changing Climate

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As per reports, global climate change might cause an increase in temperature up to 6°C by the end of 21st century which is feared to directly affect productivity of crop plants and food supply all over the world. The damage is more when temperature increase is in combination with various other kinds of biotic and abiotic stress factors. Crops that perform better under adverse and less favourable environmental conditions are the way out and pearl millet is a crop that fits in perfectly. It is a nutrient rich and climate resilient crop that can ensure increased income as well as food and nutritional security to the farming populations in arid and semi-arid regions of the globe.

Scientific predictions are realised and the globe is witnessing climatic variations characterised by an increasing temperature, extreme variations in rainfall patterns, frequent droughts and diurnal temperature variations. Global climate change is expected to increase the temperature in the range of 1.5 to 5.8°C by the end of 2100 and crop yields are predicted to decrease approximately 10% for every one-degree increase in temperature. Reduction in crop productivity affects world food supply and when combined with other biotic and abiotic stress factors, the damage is cureless. Already almost 90% of the cultivable land area is affected by various abiotic stresses, globally. Millets, in general and pearl millet which is one of the leading millet crops, efficiently withstand high temperature stress and reduced water availability during their life cycle as compared to other crops. Pearl millet, also known as bajra in India, is the sixth most important global cereal, primarily grown as a rainfed crop in the arid and semi-arid zones of India accounting for 80% of area in Asia. India has 7 million ha area under pearl millet cultivation with a production of 8.6 million tonnes. Africa has 55% of world area under pearl millet to which the 7 countries (Niger, Nigeria, Mali, Burkina Faso, Senegal, Chad and Sudan) account for more than 80%. Pearl millet is a multipurpose cereal grown for grain, stover and green fodder. Its nutrient content is equivalent or even superior to those of other cereals with a good content of protein (11%), carbohydrate (72%), fats (4–6%), vitamins and minerals particularly iron and zinc and diverse health promoting phenolic compounds. Though millet grains are on the leaner side as far as fats are concerned, bajra is an exemption with 4–6% fat content. It is not surprising why this grain is cherished as a major energy source in the arid western states of India. A high content of fibre, the most proclaimed nutritional component in

*Image Source- CAZRI, RRS, Bikaner at the time of Natural farming Workshop

millets, is available in pearl millet making it comparable to that of whole wheat atta or even oats. Iron which is the most vital mineral for a healthy and productive population is abundant in bajra and significantly higher than rice. The NIN (ICMR) survey report on the dietary iron intake of Indian states puts Gujarat on top which is not just a co-incidence considering bajra being the major staple of the state. The crop is also an important source of green fodder and stover for the cattle and is a raw material for bio-fuel production.

Climate Resilience and Cultivar Suitability

Bajra is regarded as a climate-resilient crop looking at its adaptability to a wide range of ecological conditions such as high temperature, low moisture levels and poor soil fertility. This crop can perform well with very low annual rainfall in the range of 200–500 mm and at elevated temperatures above 30^{o}C. It is among the hardiest of all crops and is grown in places which are too hot and dry for most other crops to fit in. Hence, it is looked at as one of the most significant crops in the scenario of food security and changing climate conditions. Temperature is one of the key climatic factors having profound effect on the growth and development of this crop. The soil temperatures in farmers' field in India and Africa commonly exceed 45°C and the temperatures rise as high as 60°C occasionally. In India, about 25% of the pearl millet area falls in the arid zone designated as A1 zone which comprises of parts of Rajasthan, Gujarat and Haryana receiving less than 400 mm annual rainfall. This region experiences extended dry spells, drought, heat waves and soil temperatures in farmers' fields are reported to exceed 45°C often. The cultivars suitable for cultivation in the arid zone should have early maturity (75 days of crop cycle), high tillering, good grain as well as fodder yields. Several hybrids are available for cultivation in the arid conditions, however, under extremely arid situations and where the land is poor, farmers prefer traditional landraces that have better quality over improved cultivars and use them for consumption. The OPV CZP 9802 is the outcome of landrace-based breeding and responds well to drought as well as favourable conditions. Pearl millet is also resilient to reproductive stage heat stress. The spectacular ability of this crop to endure high temperatures up to 42°C even during reproductive phase also makes it suitable as a summer crop in northern Gujarat, eastern Uttar Pradesh and parts of Rajasthan. The hybrids such as GHB 526, GHB 183, GHB 558 are suitable for summer grown conditions.

Resilience of Pearl Millet to Low Moisture and Poor Soil Fertility

Pearl millet has a deep root system which helps it to tolerate water scarcity. It wades through drought by enhancing its root length and maintaining high leaf water status. Good water status in root tissues also helps in proper nutrient acquisition. It can grow in low nutrient soil with minimum dependence on chemical fertilizers due to its high photosynthetic efficiency, superior dry matter production capacity and excellent productivity. Pearl millet belongs to the group of C_4 plants that are more efficient in fixing atmospheric CO_2 and utilizing water effectively. Moreover, there is substantial deposition of cuticular wax in pearl millet leaves which reduces transpiration water loss and helps in reflecting radiation thereby contributing to heat and drought tolerance of the crop. Its unique ability to yield good economic returns even in poor and marginal soils and harsh environmental conditions makes it a crop of choice for the arid and semi-arid regions of the world.

Pearl Millet: A Preferred Crop in Salinity Affected Arid Tracts

Soil salinity is a fast-emerging threat to crop production and salination of farmland is increasing due to several factors that are natural as well as anthropogenic. Salinity is more evident in semi-arid and arid regions where precipitation is less and evapotranspiration is more. Pearl millet is known to withstand salinity stress effectively and genes from pearl millet have been used to generate salinity tolerant rice and ground nut plants. It is even

suggested as an alternate crop for salinity affected areas. Since, the crop is mostly free from major pests and diseases, use of pesticides and fungicides is also less, making it a sustainable crop with minimum impact on the environment.

Summary

Pearl millet is among the hardiest of all crops and a great promise in climate resilient agriculture. The crop displays great potential in imparting food and nutritional security among the marginal farming communities and livestock of arid and semi-arid regions. As the crop is resilient to heat, drought, salinity and various abiotic stress factors, it's a promising alternative for the major cereal crops which might fail in the changing climatic conditions. Realizing the importance of this crop, efforts are underway for developing high yielding varieties and hybrids to suit farmers' fields in different zones of pearl millet cultivation.