

PEARL MILLET - POTENTIAL TO BOOSTS RAINFED FARMERS LIVELIHOODS AND NUTRITIONAL SECURITY

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In India, nearly 60 per cent net sown area is under rain-fed farming, which is completely dependent on monsoon rains. About 55 per cent of India's farmers rely on agriculture as a source of food, income and employment. Over the years, farmers in rain-fed areas have been facing several adversities such as climate variability, crop failure, non-remunerative prices, etc. Their adverse impact on livelihood of farmers is remarkable, as India's economy is more dependent on agriculture. To make agriculture a viable and adaptable proposition in the country, there is a need to do more research and development in rain-fed agriculture. Presently, climate change and hidden hunger are the major bottlenecks that hamper the productivity, healthiness and economic potential of people living on the margins. Crop and dietary diversification of the rain-fed region is limiting due to seasonality and socio economic status. Under this perspective, rain-fed agriculture is risk prone activity and creating panic situation in the backdrop of observed erratic weather and threatening food production and rural livelihoods. In this sense, it is very crucial to elect right crops, which have the ability to buffer crop production against these multiple stresses linked with climate change and produce sustainable yield with minimum inputs to grab the maximum profitability.

Certainly, millet crops are a critical solution to climate change and ideal option for rain-fed farming systems. Traditionally, under drought threat scenario, millets provide nutritious food as compared to other cereals with high fibre content and essential minerals. By default, millets can be grown organically and may not require chemical fertilizers and pesticides. Indeed, "Millets - Climate Smart Crops" are the hope for food-cum-nutritional security, where not only enough calories but also necessary micronutrients are taken care. More recently, successful biofortification of millets to combat chief hurdles of dry region, a

major breakthrough to beat the malnutrition and rural poverty and be more sustainable on the environment. To revive millets to mainstream, exploit their nutritional and nutraceuticals properties, Govt. of India declared the year 2018 as “National Year of Millets”. Further, acting on India’s proposal, the Food and Agriculture Organization (FAO) of the United Nations has agreed to celebrate “International Year of Millets” in 2023 with theme of improving production and productivity of the climate-resilient and nutritious millets across the globe. Furthermore, to ensure, it reaches the masses, it has been brought into the PDS (Public Distribution System) to encourage consumption of millets for balanced diet in the changed dietary pattern of the modern society. There is no doubt that a rapid shift in the cropping pattern and eating habits incorporating millets in today’s population is vital.

Promise of Pearl Millet

Technically, among the millets pearl millet is the most sustainable crop in the rain-fed conditions due to its unique traits – C₄ short duration plant with high photosynthetic efficiency, inherent high water-use efficiency and can withstand in most adverse agro-climatic conditions. It can give farmers a harvest even under water deficit/salinity/heat stress where there is none for other crops, reducing farmers’ risk of losses. It is the one of the toughest, drought-tolerant crops due to its rapid and extended root system with specialized cell walls that prevents desiccation.

Pearl millet is the cheapest source of minerals as compared to other cereals and vegetables. It is an extremely versatile ingredient of nutrients, which are vital for humans’ growth and rightly termed as “nutricereal” along with other millets. Its protein quality is superior in term of its tryptophan and lysine along with higher content of calcium, potassium, magnesium, iron, zinc as well as niacin, riboflavin, thiamine. With low prolamine fraction, pearl millet is gluten free grain and the only grain retains its alkaline properties after being cooked, which is ideal for people with gluten allergy. Pearl millet is rich in fibre content, it tends to digest slowly and release glucose at a slower rate and curbs hunger for a long span of time, as such it is powerful in controlling diabetes and aids in weight loss. It contains “phytic acid” which is believed to stabilize the level of cholesterol in the body. Regular intake of pearl millet protects from developing breast cancer and reduces secretion of bile acids and is linked to a lowered risk of gallstone formation. Pearl millet is traditionally used for food products like roti (flat bread), bhakri (stiff roti) and porridge. Unlike other millets, pearl millet required little processing for new products. Pearl millet flour mixed with wheat flour

for making baking products like breads, cakes, muffins, cookies, biscuits and non-alcoholic beverages.

Pearl millet forage has higher levels of protein content than sorghum and maize and found to be a crop of choice for animal and poultry feed, particularly in dryland areas. Pearl millet responds profitably to a balanced application of plant nutrients. In spite of the facts, the area under pearl millet cultivation has been drastically reduced over the years in India. Wherever, there are no alternatives the resource poor rain-fed farmers continue to grow in foreseeable futures to meet out the needs of food and their animal feed and fodder. Currently, in India it is mostly grown in the states of Rajasthan, Maharashtra, Gujarat, Uttar Pradesh Haryana and small fraction in other states, where weather variability and poor soil fertility with low water-holding capacity are common characters of the area. Accounting an area of 7.5 million hectare and contributing 9.73 million tonnes of grain in India. Interestingly, pearl millet productivity has increased noticeably over time, in 1981 it was 458 kg ha^{-1} which reached 1305 kg ha^{-1} in 2018.

Impact of climate change on pearl millet

With alarming concern of climate change, rise in temperature, changes in precipitation patterns and elevated CO_2 concentration are the major predicted impacts, which have significant implications on agricultural productivity. In most of the cases, pearl millet is remained answer to the erratic weather, because it offers the potential to reduce agricultural water demand and also alleviate certain micronutrients deficiencies. Peal millet can thrive well at optimum temperatures of 33°C day and 28°C night. Eventhough, the crop can tolerate temperatures of up to 42°C , whereas other cereals, like maize (40°C) and rice (32°C) and wheat (30°C) cannot handle the heat. Currently, several high yielding and heat-tolerant hybrids are available having good seed set at air temperatures as high as 46°C and finding a new niche in north-western India as a irrigated crop. Another implication of climate change is elevated Carbon dioxide (CO_2) concentration, it is expected to have positive physiological effects through increased photosynthesis and in-turn beneficial effect on crop growth and yield. The benefit of “ CO_2 fertilization” effect on yield may partially minimized the negative impacts of rising temperature. However, scientific results shows carbon penalty from increasing CO_2 concentration on protein, iron and zinc more than negates any benefits of CO_2 yield fertilization. On other hand countering the effects of rising CO_2 levels, biofortification of staple crops are likely to take on new importance.

Biofortification of Pearl Millet

Besides building climate resilience, pearl millet can effectively address the malnutrition of resource poor and life style disease of urban people. Furthermore strengthening to this, All India Coordinated Research Project on Pearl Millet prioritized nutrition in breeding by officially setting minimum standard levels of iron (42 ppm) and zinc (32 ppm), apart from giving a higher yield for the central release of pearl millet cultivars. Thus, biofortification of pearl millet through conventional breeding opens up the possibility of a cost-effective strategy to beat hidden hunger in women and children while simultaneously providing smallholder farmers a climate-ready crop to face the vagaries of climate change. The high yielding biofortified cultivars assume great significance for nutritional security. The details of recently developed and released ones through AICRP network are presented below.

S. N o	Name of hybrid/variety	Bred at	Area of adaptation	Salient features	Grain yield (kg/h)	Fodder yield (q/h)	Fe (ppm)	Zn (ppm)
Varieties								
1	Dhanshakti	Mahatma Phule Krishi Vidyapeeth, Dhule, Maharashtra	Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Rajasthan, Haryana, Gujarat, Punjab and Uttara Pradesh	Early maturing variety, bold, globular, shining slate grey coloured seed, cylindrical-Lanceolate Earhead, resistant to downy mildew	2199	53	81	43
2	Central Pearl Millet Variety ABV 04 (MP552)	ARS, ANGRAU, Ananthapura mu, Andhra Pradesh	Maharashtra, Karnataka, Andhra Pradesh, Telangana and	Medium maturing tall and erect plant type; Resistant to downy	2500	58	70	63

			Tamil Nadu.	mildew, smut and blast diseases; tolerant to drought; Panicles are thick and compact with grey coloured obovate shaped bold sized seed				
Hybrids								
3	HHB 299	Chaudhary Charan Singh-Haryana Agricultural University, Hisar	Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu.	Medium maturing, purple anther colour, Lanceolate shaped compact panicle, greyish hexagonal shape grains, resistant to major diseases and insect pests.	3274	73	73	41
4	AHB 1200 (AHB1200Fe) (MH 2072)	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbani, Maharashtra	Rajasthan, Gujarat, Haryana, Punjab, Delhi, Maharashtra, Telangana, Andhra Pradesh and Tamil Nadu.	Medium maturing, high Fe content, long cylindrical panicle, resistant to downy mildew, resistant to stem borer, highly responsive to fertilizers.	3170	70	77	39

5	AHB 1269 (AHB1269Fe) (MH 2185)	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbani, Maharashtra	Rajasthan , Gujarat, Haryana, Punjab, Delhi, Maharashtra, Telangana, Andhra Pradesh and Tamil Nadu.	Medium maturing, No n-lodging, high Fe content, cylindrical panicle, resistant to downy mildew.	3200	60	91	45
6	PhuleMahashakti (DHBH 1211/MH 2078)	Mahatma Phule Krishi Vidyapeeth, Dhule, Maharashtra	Maharashtra	Very compact earhead, bold globular grains with gray colour. Resistant to downy mildew	2900	60	87	43

To accelerate progress towards ending hunger and safeguard food security and improved nutrition, there is a dire need to promote nutrition sensitive agriculture, where in cultivation of biofortified varieties require no more water and fertilizers than the regular varieties. Consumption of biofortified pearl millet can minimize the deleterious effects of nutrient deficiencies by providing significant amount of the iron and zinc needed daily by young children and women, further resulting in profound positive impacts on livelihoods.

Performance of ABV 04

Ananthapuramu is the drought prone district of Andhra Pradesh and it is located in Scarce Rainfall Zone of the state with normal rainfall of 546.0 mm. NGOs like MYRADA have taken pearl millet to small and marginal farmers in rain-fed areas of Ananthapuramu with a vision of reintroducing millet-based multi-cropping system. With their enthusiasm a farmer A. Sreeramulu, cultivated pearl millet variety ABV 04 during *kharif* 2018, which gave encouraging results of reaping 10 quintals of grain yield per acre using just one bag of urea and no other chemicals inputs. As such, a drought tolerant variety ABV 04 has witnessed

bumper yield under 47 per cent of deficient rainfall observed during the crop season, where dismal yield of different crops were noticed.

Conclusions and Way forward

In the face of leading water scarcity, pearl millet is most preferred crop due to its adaptive climate-resilience and nutritional features that can really help the policymakers and farmers to combat drought threat situation. Promotional efforts for millets have made huge demand and significant differences in production. The productivity may be further enhanced by adoption of improved production technologies and may increase economic returns from pearl millet-based crop-livestock production systems. In an overview, pearl millet “a power house of nutrients” is easily accessible and affordable to everyone to address the issues of food security, malnutrition and climate change, while protecting the livelihoods of farmers.



[Performance of biofortified Pearl Millet variety ABV 04 during *Khari* 2018 at Kadiri mandal of Ananthapuramu, Andhra Pradesh.]

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