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SORGHUM (SORGHUM BICOLOR L.) (JOWAR): AN IDEAL CROP FOR A DETERIORATING CLIMATE

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With brutal heatwaves striking Indian cities mercilessly this year, and water scarcity increasing day by day, human, animal, and plant lives are being impacted drastically. Moreover, with increasing global warming and environmental decline, these climate change and water shortage problems seem to be only the tip of the iceberg, as compared to what we may have to face in the future. Among a multitude of steps that we need to take immediately in order to address these issues, one lies in increasing the use of crops that are drought resilient and require less water for optimum growth. One such cereal crop is Sorghum (Sorghum bicolor or jowar in Hindi). (Fig 1)

Sorghum is a C4 plant belonging to the family Poaceae, and is extensively utilised all over the world as a source of food, feed, biofuel, etc. [1] It is a drought-resistant crop with minimal nutritional requirements; therefore, it can be grown to boost water productivity and improve food security, especially in areas where water shortage is a concern and producing other crops is difficult [2].

Sorghum grain and its components are nearly the same as maize, consisting of about 8–12% protein, 65–76% starch, and 2% fibre. In addition, the germ is an excellent resource of oil, comprises a substantial amount of protein content, nearly about 19%, and ash having 10% content [3]. Sorghum is considered to be a major source of carbohydrate and a staple diet for millions of people living in arid and semi- arid regions and is also referred by the name "king of millets" [4]. Sorghum has gained attention as a viable option for producing both sugar and lignocellulosic biofuels due to its efficiency and adaptability. It requires relatively low inputs and has the capacity to flourish on marginal lands, making it an attractive option for sustainable biofuel production [5]. In addition to being a healthy source of dietary fibre, proteins, fats, and carbohydrates, sorghum may be substituted for wheat in a variety of gluten-free baked goods and is suggested as a safe food for celiac disease patients [6]. Further, sorghum grains are rich in micronutrients, antioxidants, and are often referred to as 'nutricereal' due to multiple health benefits.

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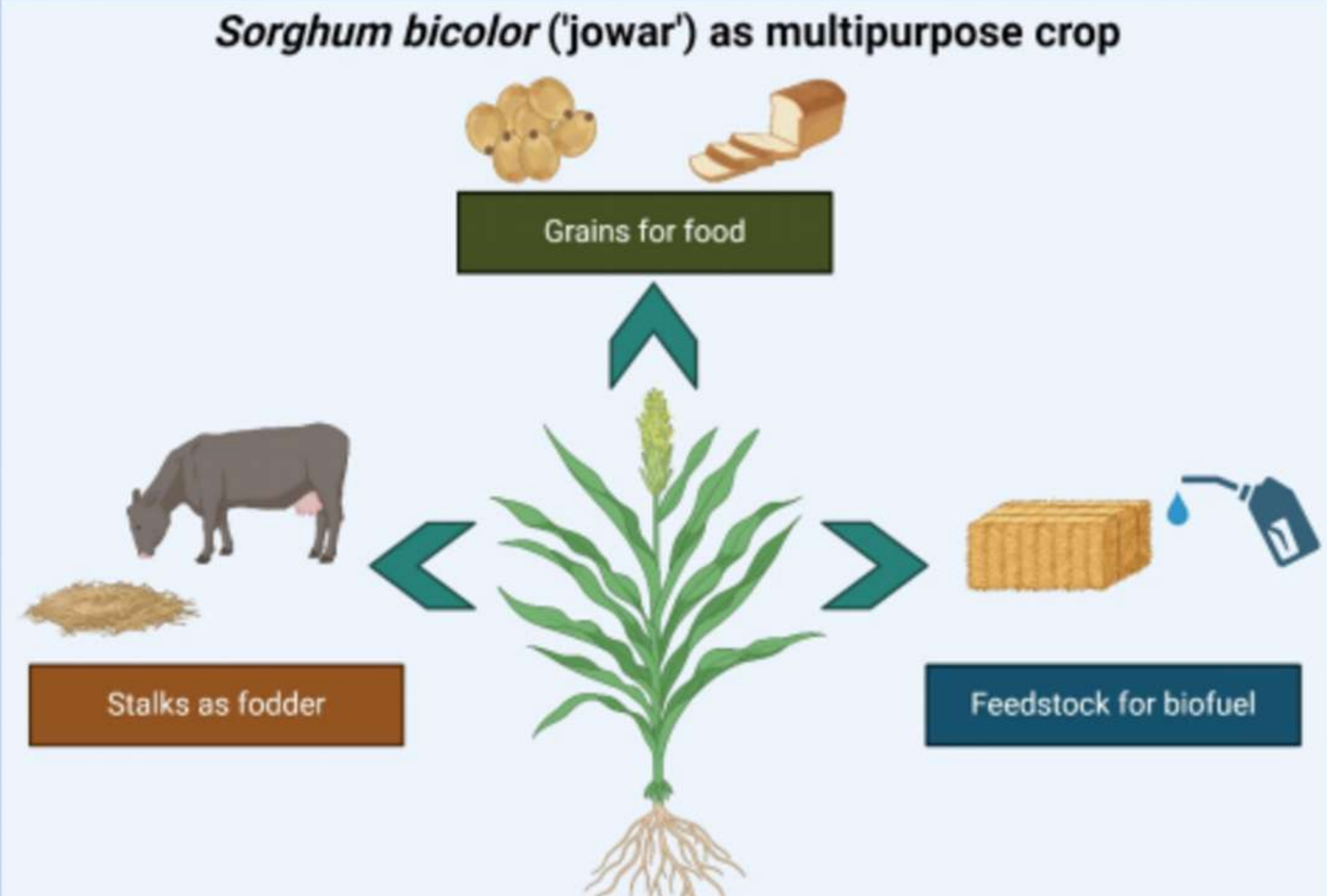

Fig. 1. Sorghum as a versatile multipurpose crop, with applications for food, fodder, and fuel. (Figure created using Biorender.com)

The five countries that produce the majority of sorghum globally are the United States, Nigeria, Sudan, Mexico and India with about 8 million, 6.7 million, 5 million, 4.8 million and 4.4 million metric tons respectively (https://www.statista.com). In India, Maharashtra and Karnataka are the major sorghum producing states accounting for 54.99% of the crop followed by Rajasthan, Tamil Nadu, Uttar Pradesh, Madhya Pradesh & Andhra Pradesh contributing 15.93%, 8.39%, 7.83%, 5.98 & 5.58% respectively (https://angrau.ac.in).(Fig 2).

With respect to the application and characteristics, sorghum has been classified into four major types: sweet, forage, biomass and grain. Grain and forage are primarily grown for human use and animal feed respectively. Grain sorghum is mainly produced to enhance the accumulation of dry matter in the form of grain [7]. Forage sorghum shows remarkable adaptability, thriving in saline soil and exhibiting tolerance against soil toxicities in contrast to other cereal crops. Furthermore, it also offers economic advantages by requiring limited irrigation and fertilizer inputs for grow. [8]. On the other hand, cultivars of sweet sorghum rich in soluble sugar concentration are mostly produced for their sugar syrup which may be distilled into alcohol [9]. Sweet sorghum, which is known for its high sugar content and ease of extractability, has become one of the top feedstock crops for next-generation biofuels, reinforcing its position as a leading choice in this innovative energy sector [5]. Biomass sorghum being photoperiod sensitive has extended vegetative growth, resulting in increase in green and dry mass production. Additionally, it features low humidity, broad tolerance, short life cycle and higher calorific value as compared to other biofuel crops [10].

The current leading cereal crops of the world, i.e. maize, wheat, rice are comparatively more susceptible to environmental threats, and require more water for growth. Contrarily, sorghum is comparable with these crops in terms of calorific value, and is better in terms of nutritional content. Thus, the potential of sorghum as multipurpose cereal crop, low water

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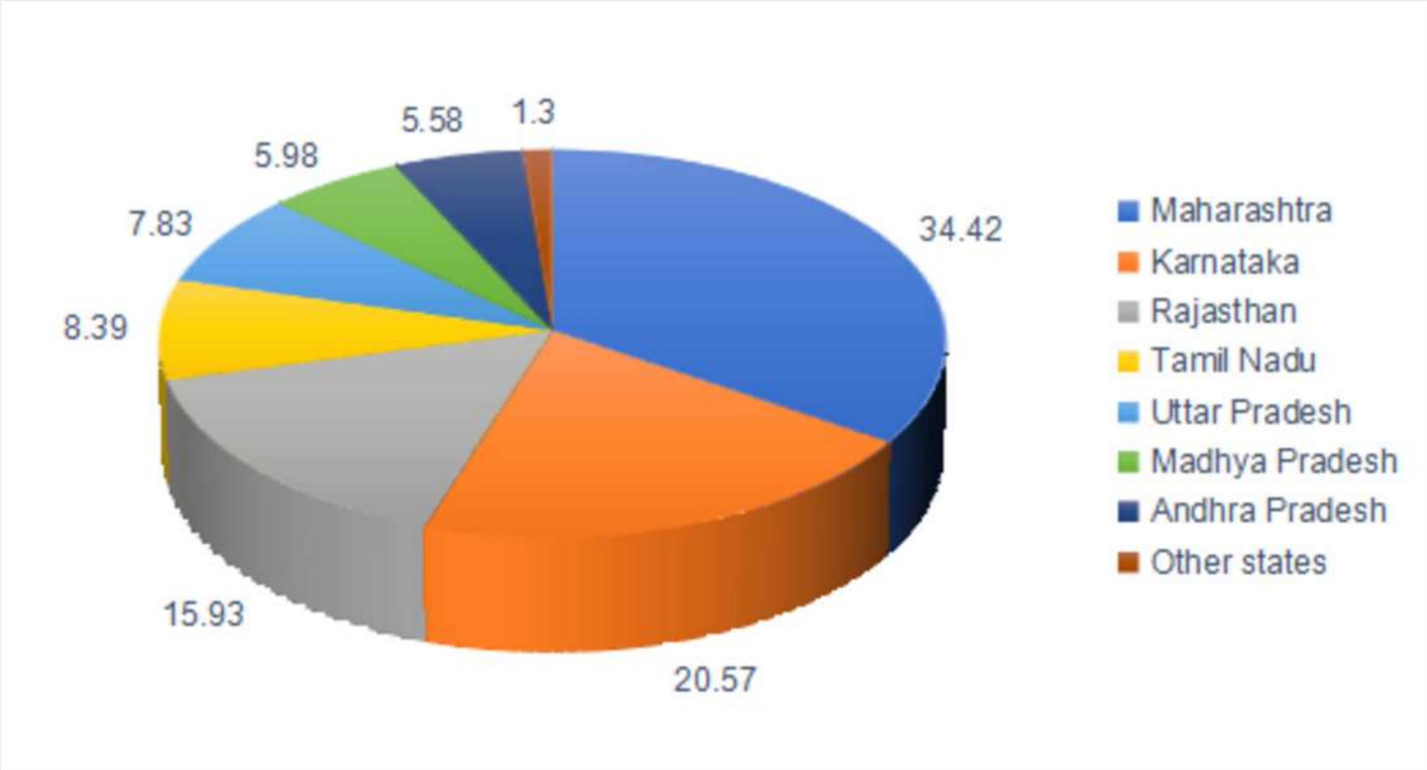

Fig 2: Percentage distribution of sorghum production across states in India.

requirements, and its high adaptability to adverse environmental conditions make it an ideal crop for the future to ensure food and nutritional security in a deteriorating environment.

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