POPULAR SCIENCE LECTURE

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Dept. of Biosciences and Botany
Union Christian College, Aluva-683102

LECTURE ON

ADVANCES IN MILLET GENOMICS FOR FOOD AND NUTRITIONAL SECURITY

BY

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DATE AND TIME

FRIDAY, JULY 7, 2023 (10:00 AM)

VENUE

T. B. NINAN HALL, U. C. COLLEGE, ALUVA - 683102

ABSTRACT

ADVANCES IN MILLET GENOMICS FOR FOOD AND NUTRITIONAL SECURITY

Human population is racing towards 10 billion by the year 2050 and ensuring the basic needs of the growing population is going to be a challenging task. Climate change, decrease in total arable land, and reduction in yields due to biotic and abiotic factors pose a significant threat to agriculture. The drastic difference in the population and the crops that are being consumed, there is an immediate requirement to mainstream the crops that are less popular and remains underutilized. One such potential but neglected and underutilized crop species are the millets, particularly, small millets. These minor millets are marginally cultivated but have the potential to withstand minimal irrigation, climate stress, insect-pest attack, diseases, etc. Foxtail millet (Setaria italica) was once a neglected species; however, the release of the genome sequence information has enabled several studies, including: (i) development of large-scale genome-wide molecular markers; (ii) high-throughput genotyping and genome-wide association studies for major traits; (iii) characterization of genes and gene families; and (iv) construction of comprehensive databases for open access into the genetic and genomic resources developed so far. This has accentuated the crop as a species with rich genetic and genomic resources, and also, the research on this crop has paved a roadmap for executing similar studies in other minor millet species. In this context, the talk will give an overview of tools and approaches used in millet genomics research and their application in generating climate-resilient major cereal crops.High temperature-induced crop failures are prominent nowadays in major staples, including rice, wheat, and maize; however, crops such as foxtail millet (Setaria italica) are resilient to temperature stress. We have identified a total of 113 heat shock protein (HSP) encoding genes in foxtail millet and a novel sHSP of foxtail millet, SisHSP27 was characterized for its role in conferring tolerance to high-temperature stress. SisHSP27 is a panicoid-specific gene, which is highly upregulated during high-temperature in leaves, and the protein is localized in the chloroplast. Its expression is directly regulated by heat shock factor, SiHSFA2e, during temperature stress. Further, overexpression of SiHSP27 in rice enhanced the survival of transgenics during high-temperature stress (>80% survival frequency), and the transgenic lines showed improved plant architecture and overall grain yield. Compared to WT plants, transgenic lines maintained optimal photosynthesis rates with higher photosystem efficiencies at high temperatures, and this is conferred through protecting the components of photosystems, chlorophyll-binding proteins, and chloroplast-localized functional proteins by SisHSP27. Prolonged high-temperature stress showed minimal damage to chloroplast proteins resulting in comparatively lower yield loss (35-37%) in transgenic lines. Altogether, the study suggests that SisHSP27 is a potential candidate for designing thermotolerant crops for climate-resilient agriculture.