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Abiotic Stress Responses of Horticultural Crops: Bhlh Transcription Factor Characteristics and Roles

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Abstract

Abiotic stressors are important environmental elements that have an impact on crop quality, productivity, and growth. One of the biggest families of transcription factors (TFs) in plants, the bHLH family is crucial to many distinct abiotic stress response pathways, including those in response to water deficiency, high salt, low temperature, and nutritional deficits. Numerous research in model plants have investigated the functions and regulatory mechanisms of members of the bHLH family in the response to abiotic stress since the discovery of the bHLH family in plants. The regulation of abiotic stress response and resistance in horticulture crops has been the subject of substantial research in recent years. Reviewing these studies can shed light on them and provide new paths for research on horticulture crops' abiotic stress responses. Here, we focus on the function and regulatory mechanisms of important bHLH while summarising the structure, categorization, and regulation of bHLH TFs.

Keywords: bHLH transcription; Abiotic stress responses, Horticultural crops

Introduction

A class of proteins known as transcription factors (TFs) control the transcription of target genes by specifically binding to cis-elements in the promoter regions upstream of the start codon (Xiong et al., 2005). TFs are important transcriptional regulators of gene expression that aid plants in responding to environmental cues. Basic helix-loop-helix proteins (bHLHs), which are found in many eukaryotes and are distinguished by a highly conserved basic helix-loop-helix domain. After the MYB family, the bHLH family is the second-largest TF family in plants (Feller et al., 2011). The bHLH family of transcription factors has a role in every stage of plant development and growth. Numerous studies have demonstrated the involvement of bHLH TFs in the control of numerous synthetic metabolic and signalling processes in plants. , influencing processes such seed germination, photo morphogenesis, flowering, leaf senescence, and apoptosis [1].

Materials and Method

The bHLH domain's identification and description

The HLH structure of mouse TFs E12 and E47 was initially uncovered by Murre et al. in 1989. The first bHLH TFs in maize (Zea mays L.) were discovered in the same year (Ludwig et al., 1989). Afterwards, X-ray diffraction was used to determine the three-dimensional structure of the complex of the Max protein binding DNA bHLH domain, and it was found that Max binds to the target sequence as a dimer (Ferredamare et al., 1993). The bHLH TF family is the result of years of study [2].

Factors influencing the bHLHs' transcriptional activity

Abiotic stresses such drought, salt, extreme temperatures, and nutrient deficits significantly restrict the productivity, quality, and geographic spread of horticulture crops globally as a result of global climate change and environmental degradation. For the purpose of stress-resistant breeding of horticultural crops, it is crucial to investigate the key factors in abiotic stress response and elucidate their regulatory mechanisms. Understanding how plants sense stress signals and adapt to challenging environments is a fundamental biological question. The bHLH family of transcription factors has been extensively investigated in plants and has a wide range of different impacts on abiotic stress responses and resistance modulation.

The importance of bHLHs in controlling abiotic stress response in horticulture crops has been demonstrated in a growing number of researches in recent years. Several important bHLH proteins that may link various signalling pathways in abiotic stress response have also been found. There is currently no review of bHLH TFs that is explicitly focused on horticulture crops; instead, existing reviews of bHLH TFs are primarily focused on studies in model plants, such as Arabidopsis and rice. In order to provide a theoretical foundation and genetic resources for enhancing the yield and quality of horticultural crops, we introduce the characteristics of the bHLH family TFs and review the function and regulatory mechanisms of the bHLH family proteins in the abiotic stress responses and resistance of horticultural crops [3-5].

Function and regulatory mechanisms of bHLH TFs in controlling horticulture crops' abiotic stress response

The functions of bHLH TFs in plants in controlling the abiotic stress response have been the subject of numerous reviews up to this point, but there isn't a comprehensive overview for horticulture crops. Determining the role and regulatory mechanisms of bHLH TFs in controlling the abiotic stress response in horticulture crops is therefore our main emphasis [6-8].

Discussion

Abiotic stresses have traditionally posed serious issues for agricultural development, including deserts, salinization, extremely high temperatures, and nutrient shortages. A significant TF family that controls both the stress response and plant growth and development

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is the bHLH family. The processes underpinning the plant's reaction to external stresses have been the subject of several researches, but there are still many open questions regarding the extensive dynamic crosstalk between the signalling channels [9, 10].

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Potential Conflicts of Interest

The author has no conflict of interest.

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