Crimson Publishers
Wings to the Research

Opinion

Genetic Approaches for Sustainable Production of Onion Against Abiotic Stresses

Usman KC*, Zahide NOG and Ali FG

Department of Agricultural Genetic Engineering, Niğde Ömer Halisdemir University, Türkiye

ISSN: 2637-7802

Abstract

Onion (*Allium cepa* L.) is the main bulbous crop cultivated commercially globally. It is the main condiment crop and consumed second in number after tomato. Contrarily, abiotic stresses are impacting the growth, yield, and quality of the onion. Single stress is significantly resulting in poor yield, whereas combined abiotic stresses are resulting in devastating yield losses under natural conditions. Additionally, it is predicted the water scarcity is increasing on yearly basis and it also triggers other abiotic stresses. Therefore, it is the major threat to onion production, and it is predicted to cause devastating yield losses. Modern genetic approaches have broadened our horizon to develop stress resilient vegetables to cope with future climatic changes to ensure food security. Several studies have reported the influence of single and combined abiotic stresses on major vegetable crops. However, limited literature is available to understand the response of onion to single and combined abiotic stresses. It is the dire need of the hour to study the response of onion to abiotic stresses. This opinion report enlightens the importance of modern genetic approaches for development of stress tolerant onion cultivars.

***Corresponding author:** Usman Khalid Chaudhry, Department of Agricultural Genetic Engineering, Ayhan Şahenk Faculty of Agricultural Sciences and Technologies, Niğde Ömer Halisdemir University, Niğde, Türkiye

Submission: June 11, 2022

Published: June 28, 2022

Volume 2 - Issue 5

How to cite this article: Usman KC, Zahide NOG, Ali FG. Genetic Approaches for Sustainable Production of Onion Against Abiotic Stresses. Biodiversity Online J. 2(5). BOJ. 000550. 2022.

Opinion

World population is increasing at a rapid pace that is demanding for more food. Additionally, climatic changes are causing reduction in vegetable production on yearly basis. It is present need to adapt vegetables to cope with harsh climatic conditions to ensure food supply for future generations. Onion is the major vegetable crop that is consumed both as a raw or as condiment in every cuisine due to its unique aroma and taste around the globe. Onion is adapted to wide range of climatic conditions, but harsh environmental conditions result in significant yield losses. Abiotic stress is an environmental factor that negatively effects the growth, yield of onion. The major abiotic stresses include water deficiency (drought), excessive accumulation of salt (salinity), fluctuation in temperature (heat/cold), environmental pollutants (heavy metal) stresses. The single stress alone results in yield losses. However, under natural conditions plants often suffer from combined abiotic stresses that results in poor growth and ultimately devastating yield losses. These stresses need to be addressed to ensure food security. Studies have been conducted on major vegetable crops to circumvent combined abiotic stress problems and unravel tolerance mechanisms. Additionally, the introduction of genetic approaches further enhanced the knowledge of vegetables and speedup the process for the development of tolerant varieties. Although least literature has been reported regarding the response of onion to single stress [1]. Onion has a shallow root system that can penetrate up to 76cm, but its root lies at 18cm with only some reports of its penetration to 31cm. These characteristics make it prone to abiotic stresses. The water available in the deeper soil pockets is unavailable for onion uptake that causes drought conditions. The salt accumulates in the upper surface of the soil causes salt stress problems. Additionally, higher salt concentration in the vicinity of the roots disturbs the water potential for its uptake by plants that results in soil and drought stress conditions simultaneously. Both stresses effects the physio-biochemical functioning of the onion. As the first response of plant

is stomatal closure to limit the loss of water. It effects the gaseous exchange of the onion resulting in oxidative stress and damage to photosynthetic pigments [2]. The oxidative stress is caused by the excessive production of reactive oxygen species (ROS). It includes superoxide anion ($O_2 \cdot -$), singlet oxygen ($^1O_2$), Hydroxyl Radicals (·OH), hydrogen peroxide (H_2O_2). These are alleviated by antioxidant enzymes such as Superoxide Dismutase (SOD), Catalase (CAT), and Ascorbate Peroxidase (APX) to minimize the impact of oxidative stress. These antioxidant enzymes accumulation varies among sensitive and tolerant. Their higher accumulation is related to the tolerance nature of the cultivars that helps in protection of cellular membranes. The antioxidant enzymes are synthesized with the transcription of gene in response to abiotic stresses. The tolerant cultivar shows higher upregulation of genes that accumulates elevated levels of SOD, CAT, and APX, whereas sensitive cultivars fail to accumulate and suffers from higher oxidative stress [3].

The classical plant breeding approaches have been exploited successfully for vegetable improvement, but these are laborious and time consuming. With the advent of new plant breeding techniques stress tolerant vegetables have been developed with less efforts. The utilization of genome editing techniques developed mutants to upregulate/downregulate the expression of desired genes. It has been exploited for mutant development of tomato, potato, but still onion has been ignored for trait improvements. Additionally, omic approaches such as transcriptomics, proteomics, and metabolomics have been utilized to understand and unravel functioning of genes in response to stresses. It has been extensively studied in major vegetables; contrarily limited knowledge is available regarding onion response to abiotic stresses [4]. It might be due to large genome size (16Gb) of onion that has not been sequenced yet. The novel information regarding onion response at molecular levels is essential for stress tolerance. It will also help to speed up the breeding programs to develop stress tolerant onion varieties.

References

1. Chaudhry UK, Gökçe ZN, Gökçe AF (2020) Effects of salinity and drought stresses on the physio-morphological attributes of onion cultivars at bulbification stage. International Journal of Agriculture and Biology 24(6): 1681-1689.
2. Gökçe ZNÖ, Gökçe AF, Junaid MD, Chaudhry UK (2022) Morphological, physiological, and biochemical responses of onion (*Allium cepa L.*) breeding lines to single and combined salt and drought stresses. Euphytica 218: 229.
3. Chaudhry UK, Gökçe ZNÖ, Gökçe AF (2021) Drought and salt stress effects on biochemical changes and gene expression of photosystem II and catalase genes in selected onion cultivars. Biologia 76(10): 3107-3121.
4. Ghodke P, Khandagale K, Thangasamy A, Kulkarni A, Narwade N, et al. (2020) Comparative transcriptome analyses in contrasting onion (Allium cepa L.) genotypes for drought stress. PloS one 15(8): 0237457.