MIRZO ULUG‘BEK NOMIDAGI
O‘ZBEKISTON MILLIY UNIVERSITETI
JIZZAX FILIALI



"BIOTEXNOLOGIYANING RIVOJLANISH ISTIQBOLLARI VA MUAMMOLARI"

MAVZUSIDAGI RESPUBLIKA MIQYOSIDAGI ILMIY-TEXNIK ANJUMAN TO‘PLAMI





28-29-MART
2025-YIL

doi

Google Scholar

O‘ZBEKISTON RESPUBLIKASI OLIY TA’LIM, FAN VA INNOVATSIYALAR VAZIRLIGI

MIRZO ULUG‘BEK NOMIDAGI O‘ZBEKISTON MILLIY UNIVERSITETINING JIZZAX FILIALI

BIOTEXNOLOGIYANING RIVOJLANISH ISTIQBOLLARI VA MUAMMOLARI

RESPUBLIKA ILMIY ANJUMANINING TEZISLAR TO‘PLAMI

28-29 mart 2025 y

***

МИНИСТЕРСТВО ВЫСШЕГО ОБРАЗОВАНИЯ, НАУКИ И ИННОВАЦИЙ РЕСПУБЛИКИ УЗБЕКИСТАН

ДЖИЗАКСКИЙ ФИЛИАЛ НАЦИОНАЛЬНОГО УНИВЕРСИТЕТА УЗБЕКИСТАНА ИМЕНИ МИРЗО УЛУГБЕКА

СБОРНИК ТЕЗИСОВ РЕСПУБЛИКАНСКОЙ НАУЧНОЙ КОНФЕРЕНЦИИ

«ПЕРСПЕКТИВЫ И ПРОБЛЕМЫ РАЗВИТИЯ БИОТЕХНОЛОГИЙ»

28-29 марта 2025 г.

JIZZAX – 2025

birga, arpa o‘simligining fotosintez faoliyatini va oziq moddalarini tejash qobiliyatini yaxshilashga ham erishish mumkin.

Xulosa: CRISPR-Cas9 texnologiyasi yordamida arpada qurg‘oqchilikka chidamli genotiplarni yaratish ilmiy va amaliy jihatdan katta ahamiyatga ega. Ushbu texnologiya orqali arpa genomini tahrirlab, qurg‘oqchilikka qarshi turish qobiliyatini oshiruvchi genetik o‘zgarishlar kiritish mumkin. Bu esa kelajakda qishloq xo‘jaligida hosilni ko‘paytirish va suv resurslaridan samarali foydalanishni ta'minlashda muhim rol o‘ynaydi.

Foydalanilgan adabiyotlar:

1. Abdul Sami, Zhau Xue, Saheera Tazein, Ayesha Arshad (January 2021). "CRISPR-Cas9-based genetic engeenering for crop improvement under drought stress” DOI:10.1080/21655979.2021.1969831
2. Gyanendra Kumar Rai, Danish Mushtaq Khanday, Radeep Kumar, Isha Magotra (2023). "Enhansing Crop Resiliense to Drought CRISPR-Cas9 Genome Editing."Plants 12(12), DOI:10.3390/plants12122306.
3. Seyedeh Mehri Javadi, Zahra-Sadat Shobbar, Asa Ebrahimi& Maryam Shaxbazi. (2021). "New insights on key genes involved in drought stress response of barley: gene networks reconstruction, hub end promotor analysis." Journal of Genetic Engeering Biotechnology.
4. YusupovA.N. Ayubov M S, Bexzod Mamajonov O., Pazlieva L.X., O’zR FA Genomika va bioinformatika markazi CRISPR/Cas9 texnologiyasi yordamida soya genomini tahrirlash. 2181-1601. 2021

DEVELOPING ABIOTIC STRESS-RESISTANT TOMATO GENOTYPES USING CRISPR/CAS9 TECHNOLOGY

Turayev O.S., Rajametov Sh.N., Atamirzayeva R.A.
Scientific Research Institute of Plant Genetic Resources
E-mail: ruhangizatamirzayeva@gmail.com

Abstract: This research explores the potential of using CRISPR/Cas technology to develop tomato (*Solanum lycopersicum L.*) genotypes that are resistant to abiotic stresses such as drought, salinity, and extreme temperatures. Abiotic stress represents a significant challenge to global agricultural productivity, particularly in regions affected by climate change. By utilizing the precision of CRISPR/Cas systems to modify specific genes involved in stress tolerance, this study aims to create tomato varieties with enhanced resilience. The benefits of CRISPR-based breeding include rapid development of desirable traits, reduced reliance on chemical treatments, and an overall increase in food security.

Key words: CRISPR/CAS9, tomato, gene editing, abiotic stress, NHX1, HSPs, DREB1, PCR.

Tomato (Solanum lycopersicum L.) is one of the most widely cultivated and economically significant vegetables globally. However, its productivity is severely limited by various abiotic stresses, including drought, salinity, and extreme temperatures, which are exacerbated by climate change. Abiotic stress negatively impacts plant growth, yield, and quality, leading to significant losses in agricultural production. Conventional breeding methods to improve stress tolerance in tomatoes have been slow and often limited by genetic variation. However, advances in genome editing, particularly the CRISPR/Cas system, have opened new avenues for precision breeding [1-2]. CRISPR/Cas technology, initially discovered as a bacterial immune defense mechanism, has revolutionized plant genetics by allowing targeted modifications of the genome with high precision. The CRISPR/Cas system works by introducing double-strand breaks in DNA at specific loci, followed by either gene knockouts or insertions that can confer desired traits, such as stress tolerance. The CRISPR/Cas system is particularly useful for modifying genes involved in stress response pathways, such as those encoding transcription factors, enzymes, and proteins associated with stress tolerance mechanisms [3].

This thesis aims to explore the potential of CRISPR/Cas technology to generate tomato genotypes that can withstand the adverse effects of abiotic stresses. By focusing on specific genes responsible for drought resistance, salinity tolerance, and temperature stress adaptation, this research investigates how CRISPR/Cas can be employed to improve tomato productivity and sustainability in challenging environments [4].

Literature Review

1. Abiotic Stress in Tomato Plants

- Abiotic stress includes factors such as drought, salinity, extreme temperatures, and heavy metals. Tomatoes, being a high-water-demanding crop, suffer greatly from water scarcity (drought) and soil salinity [5].
- Temperature fluctuations, particularly heat stress, negatively affect tomato flower development and fruit set [5].

2. CRISPR/Cas Technology

- CRISPR/Cas9 is a genome-editing tool that allows for precise modifications at specific genomic loci. In plants, CRISPR/Cas9 can be used for gene knockouts, knock-ins, and the activation or repression of target genes [6].

- The application of CRISPR/Cas9 to improve abiotic stress tolerance in crops has shown great potential in model species such as Arabidopsis and rice [7].

3. Genetic Pathways of Abiotic Stress Tolerance

- Stress tolerance in tomatoes involves complex networks of signaling pathways that regulate gene expression. Key genes involved in drought stress include those related to water retention, root development, and osmotic regulation [8].
- The methodology section of this study focuses on how CRISPR/Cas technology Salinity tolerance is primarily mediated by ion transporters and osmotic regulators, which help to maintain cellular homeostasis under high salt concentrations [8].
- Heat stress tolerance involves heat shock proteins and protective enzymes that mitigate damage to cellular structures [9].

Methodology

will be employed to create stress-resistant tomato varieties. This includes the following steps:

1.Selection of Target Genes

- Genes known to be involved in abiotic stress tolerance will be selected. These include transcription factors such as DREB1 for drought tolerance, NHX1 for salt tolerance, and HSPs for heat tolerance [6].

2.CRISPR/Cas9 Vector Construction

- A CRISPR/Cas9 vector will be constructed, which includes the Cas9 protein and single guide RNA (sgRNA) sequences targeting the selected genes [7].

3.Transformation and Regeneration

- Tomato plants will be transformed using Agrobacterium-mediated transformation or particle bombardment methods to introduce the
- CRISPR/Cas9 construct into the plant genome [9].

Transgenic plants will be regenerated and confirmed through PCR and sequencing to verify successful genome editing [6].

4.Stress Exposure and Phenotypic Analysis

- Transgenic plants will be subjected to controlled abiotic stress conditions (drought, salinity, and temperature).
- Stress tolerance will be assessed based on parameters such as survival rate, leaf water content, growth rate, and yield [8].

Results and Discussion

The results will focus on the phenotypic changes observed in the edited tomato plants, comparing them to wild-type controls under stress conditions. Key points to address will include:

Drought Tolerance: How specific gene edits enhanced water retention and improved the plant's ability to survive prolonged dry conditions [5].

Salinity Tolerance: The role of ion transporters in maintaining cellular integrity under salt stress and the resulting improvement in plant growth [8].

Heat Stress Tolerance: The enhancement of heat shock protein expression and its protective role in cellular structures during high temperatures [9].

Conclusion

In conclusion, CRISPR/Cas technology represents a powerful tool for developing tomato genotypes with enhanced resistance to abiotic stresses. By precisely editing genes involved in stress tolerance, it is possible to create varieties that are better suited to withstand environmental challenges, thus improving crop yields and food security in the face of climate change [6]. The success of this research will contribute to the growing body of knowledge in the field of plant genome editing and may pave the way for the development of more resilient crops. Future research should explore the long-term stability of these modifications and the potential for commercialization [7].

References

1. Belhaj, K., et al. (2015). Editing plant genomes with CRISPR/Cas9. PLoS Biology, 13(4), e1002130.
2. Zhang, F., et al. (2017). CRISPR/Cas9 for plant genome editing: progress and perspectives. Plant Genome, 10(1), 1-12.
3. Wang, H., et al. (2016). Targeted genome editing in plants using CRISPR/Cas9 system. Methods, 101, 45-55.
4. Zhou, H., et al. (2018). CRISPR/Cas9-mediated gene editing and its application in crop improvement. Frontiers in Plant Science, 9, 1503.
5. Hussain, N., et al. (2020). Application of CRISPR/Cas9 in crop improvement: Potential and challenges. Frontiers in Plant Science, 11, 245.
6. Zhang, Y., et al. (2016). Utilization of CRISPR/Cas9 in plant genetic engineering: A review. Molecular Plant Breeding, 7(1), 1-12.
7. Liu, X., et al. (2019). CRISPR-Cas9-mediated genome editing for improved stress tolerance in crops. Frontiers in Plant Science, 10, 799.
8. Muthusamy, M., et al. (2018). Genetic improvement of abiotic stress tolerance in crops through CRISPR/Cas9 technology. Plant Cell Reports, 37(8), 1229-1241.
9. Sun, Y., et al. (2017). Heat stress tolerance in plants: Role of CRISPR/Cas9 in engineering heat stress-related genes. Plant Molecular Biology, 94(5), 677-689.