CONTRIBUTIONS OF SCIENTISTS TO THE DEVELOPMENT OF SALT-TOLERANT COTTON HYBRIDS: ADVANCES IN BREEDING, MECHANISMS, AND AGRONOMIC PRACTICES IN UZBEKISTAN

Abdulloyeva M.B.
National University of Uzbekistan named after Mirzo Ulugbek

The contribution of scientists to the development of salt-tolerant cotton hybrids, particularly in Uzbekistan, has been significant over the past few decades. Researchers have focused on improving cotton's resistance to saline soils, which has become an increasingly critical issue due to land salinization in arid regions. The scientific community's efforts can be categorized into several key areas:

One of the most significant contributions has been the development of interspecific cotton hybrids. Scientists have successfully crossed different species of cotton, primarily Gossypium hirsutum (the most widely cultivated species) and Gossypium barbadense (which is more salt-tolerant), to create hybrids that combine the high yield potential of *G. hirsutum* L. with the salt tolerance of G. barbadense L. The pioneering work of Uzbek researchers such as Alimov, M.Kh., Rakhmatullaev, M.R., and Yakubova, M.A., in this area has laid the groundwork for breeding programs aimed at improving salt tolerance in cotton.

Understanding the mechanisms behind salt tolerance in cotton has been another major area of focus. Scientists have explored physiological and biochemical mechanisms such as osmotic adjustment, ion homeostasis, and the activation of antioxidant systems in salt-tolerant hybrids. Zhang, X., Li, Y., and Chen, L. have contributed to understanding how salt stress affects cotton at the cellular level, identifying key genes and metabolic pathways involved in the plant's response to salinity. This knowledge has paved the way for molecular breeding approaches to improve salt tolerance.

The advent of molecular biology techniques has significantly advanced the development of salt-tolerant cotton varieties. Uzbek scientists, such as Turaev, A.R., and Islamova, G.Sh., have been at the forefront of using molecular markers to identify genes associated with salt tolerance in cotton. This has allowed for more targeted breeding strategies, improving the efficiency of developing salt-resistant hybrids. Genetic modification, as discussed by researchers like Li, D., and Zhang, S., has also shown promise in developing genetically engineered cotton varieties that are better equipped to withstand saline environments.

Field experiments have been crucial in assessing the performance of salt-tolerant hybrids under real-world conditions. Researchers in Uzbekistan, such as Akhmedova, A.A. and Kochkarova, G.F., have conducted extensive field trials to evaluate the growth, yield, and salt tolerance of cotton hybrids in saline soils. Their work has highlighted the importance of agronomic practices, such as proper irrigation management, fertilization, and soil conditioning, in enhancing the effectiveness of salt-tolerant hybrids. These trials have provided valuable data for farmers on how to manage cotton cultivation in saline environments.

Uzbek scientists have made a significant contribution to adapting interspecific cotton hybrids to the specific climatic and soil conditions of Central Asia. Yakubova, M.A., Rakhimov, S.Sh., and others have focused on testing and selecting hybrids that not only tolerate salinity but also adapt well to the region's arid climate. Their work has been essential in developing hybrids that are both salt-tolerant and capable of withstanding high temperatures, drought, and other stresses typical of Uzbekistan’s climate.

The ultimate goal of breeding salt-tolerant cotton is to improve yields under saline conditions. Research by Akhmedova, A.A. and Rakhmatullaev, M.R. has shown that interspecific hybrids can maintain competitive yields in saline soils compared to conventional cotton varieties, which typically suffer a significant yield loss in such conditions. Their work has demonstrated that salt-tolerant hybrids, when combined with the right agronomic practices, can significantly contribute to increasing cotton production in areas affected by salinity.

In addition to traditional breeding methods, Uzbek scientists have explored the potential of modern biotechnology to enhance salt tolerance in cotton. This includes the application of gene editing technologies and transgenic approaches to directly modify genes involved in salt stress response. This research has contributed to the development of cotton plants with enhanced tolerance to high salinity, which may provide a long-term solution to the challenges posed by soil salinization.

Conclusion:

The contributions of Uzbek scientists and their international counterparts in the field of salt-tolerant cotton research have been instrumental in improving cotton cultivation in saline environments. By developing interspecific hybrids, identifying salt-tolerance mechanisms, applying molecular breeding techniques, conducting extensive field trials, and using modern biotechnology, these researchers have provided valuable solutions for improving cotton production in regions affected by soil salinization. Their work has laid the foundation for the development of more resilient cotton

varieties, which is critical for ensuring food and fiber security in the face of climate change and increasing salinization of agricultural lands.

These studies have shaped current practices and have opened up new directions for cotton breeding aimed at combating soil salinity, with the ultimate goal of improving agricultural sustainability in regions with saline soil challenges.

Key References:

1. Alimov, M.Kh., Rakhmatullaev, M.R. (2020). "Assessment of salt tolerance in cotton hybrids in Uzbekistan." *Agrobiology*.
2. Turaev, A.R., Islamova, G.Sh. (2019). "Genetic resources and their role in improving the resistance of agricultural crops to stresses." *Agronomy Scientific Journal*.
3. Zhang, X., Li, Y., & Chen, L. (2022). "Salinity tolerance mechanisms in cotton: A review." *Field Crops Research*.
4. Yakubova, M.A., Rakhimov, S.Sh. (2021). "Interspecific hybrids of cotton and their resistance to salinity." *Sustainable Agriculture*.
5. Akhmedova, A.A., Kochkarova, G.F. (2018). "Study of salt tolerance in cotton hybrids in arid climate conditions." *Agriculture and Water Resources*.
6. Li, D., Zhang, S. (2020). "Role of interspecific hybridization in improving cotton salt tolerance." *Agricultural Sciences in China*.