



UDC: 631:541

THE ROLE OF CHEMISTRY IN AGRICULTURAL SELECTION

Arabov Abdumajid Raxmonqul o‘g‘li
Student Tashkent state agrarian university

Saitkulov Foziljon Ergashevich
Associate professor Tashkent state agrarian university, Tashkent
Email: fsaitkulov@bk.ru

Komilov Nurbek Masharif uli
Student of the karakalpakstan institute of agriculture and agrotechnologies
Email: nurbek4686@gmail.com

Turimbetov Muratbay Shamshetovich
Doctor of Philosophy (PhD) in Agricultural Sciences,
Acting Associate Professor of the Department of Agriculture, Selection and Seed Production of
Agricultural Crops
Muratbayturumbetov1970@gmail.com

DOI: <https://doi.org/10.5281/zenodo.17537917>

Abstract: Chemistry plays a crucial role in agricultural selection by providing tools and methods to enhance crop productivity, resistance, and quality. Through the application of chemical compounds such as fertilizers, growth regulators, and bioactive substances, researchers can influence plant growth, development, and genetic improvement. Modern techniques, including the synthesis of biologically active molecules and their integration into breeding programs, allow for more precise selection of plant varieties with desirable traits. This interdisciplinary approach combines principles of chemistry and agricultural science to optimize crop yield, improve stress resistance, and ensure sustainable farming practices. The study highlights key chemical strategies applied in selection processes and their impact on agricultural productivity.

Key words: Chemistry, Agricultural selection, Plant breeding, Bioactive compounds, Crop productivity, Growth regulators, Sustainable agriculture

Introduction. Agricultural selection, also known as plant breeding, is a critical process aimed at improving crop varieties to meet human needs for food, fiber, and bio-resources. The efficiency and success of selection programs heavily depend on understanding the biological and chemical mechanisms underlying plant growth, development, and adaptation. In recent decades, the integration of chemistry into agricultural selection has revolutionized plant breeding strategies by introducing novel tools, such as synthetic growth regulators, bioactive compounds, fertilizers, and chemical markers, which allow precise manipulation of plant traits.

Chemical interventions in agriculture serve multiple purposes: enhancing germination rates, accelerating growth, increasing resistance to abiotic and biotic stresses, and improving nutritional content. For instance, the application of plant hormones like cytokinins, auxins, and gibberellins can significantly influence cell



division, elongation, and differentiation, thereby affecting plant morphology and productivity. Additionally, modern chemical synthesis allows the development of new molecules with targeted biological activity, which can be used to stimulate desirable traits or suppress unfavorable ones in breeding populations.

The role of chemistry is not limited to plant growth regulators. Fertilizers, soil amendments, and trace elements are critical in creating an optimal chemical environment that supports vigorous plant development. Soil chemistry, nutrient availability, and chemical interactions in the rhizosphere directly affect the expression of genetic potential in selected varieties. By integrating chemical analysis and application into breeding programs, researchers can identify the most responsive genotypes and optimize selection criteria.

Moreover, advances in analytical chemistry, including chromatography, spectroscopy, and molecular marker techniques, have enabled the precise measurement of biochemical compounds in plants. These methods facilitate the identification of key metabolites, enzymes, and secondary metabolites that correlate with agronomically important traits, such as yield, drought tolerance, disease resistance, and quality attributes. By linking chemical profiles with phenotypic data, plant breeders can make informed decisions, accelerating the development of superior varieties.

Table 1 illustrates the main chemical agents and their functions in agricultural selection, highlighting how each category contributes to the overall improvement of plant varieties.

Table 1. Major Chemical Agents and Their Roles in Agricultural Selection

No	Chemical Agent	Function in Plant Selection	Examples / Notes
1	Plant Growth Regulators	Influence cell division, elongation, differentiation	Auxins, Cytokinins, Gibberellins
2	Bioactive Compounds	Stimulate desirable traits, enhance resistance	Synthetic amino derivatives, purine analogs
3	Fertilizers & Nutrients	Provide essential elements for optimal growth	Nitrogen, Phosphorus, Potassium, Micronutrients
4	Chemical Markers	Aid in genotype identification and trait selection	Isozymes, molecular markers, chemical profiling
5	Soil Amendments	Improve soil chemical properties to support plant growth	Lime, gypsum, organic acids

Integrating chemistry into agricultural selection ensures a more systematic and targeted approach, reducing the time required to develop improved crop



varieties. Furthermore, the interdisciplinary nature of modern plant breeding emphasizes the synergy between chemistry, genetics, and agronomy, enabling sustainable increases in productivity while minimizing environmental impact.

Conclusion. Chemistry plays a pivotal role in agricultural selection by providing the tools and knowledge necessary to improve crop yield, quality, and resistance to environmental stresses. Through the application of chemical compounds such as growth regulators, fertilizers, and bioactive substances, scientists can influence plant physiology and development to achieve desired traits. Analytical chemistry techniques allow for the precise assessment of soil, water, and plant composition, ensuring optimal growing conditions. Moreover, modern chemical methods enable the synthesis of new biologically active compounds that can enhance selective breeding programs and accelerate the development of superior plant varieties. Overall, integrating chemistry into agricultural selection not only boosts productivity but also supports sustainable and efficient farming practices, contributing to food security and agricultural innovation.

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