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ASPECTS OF ENDOGENOUS REGULATION OF PLANT GROWTH

The article is devoted to the aspects of the use of hormonal preparations in agricultural crop production. Plant growth processes are largely determined by internal factors among which hormonal regulation occupies the main place. The study of plant growth patterns is of great importance for the development of methods of modeling, programming and forecasting the yield of agricultural plants. Growth regulators of hormonal nature have shown their effectiveness in solving many problems: in cultivation of various agricultural and technical crops, for example, to increase plant resistance to stress factors of different nature, induction of plant defenses, sexualization, flowering, acceleration of fruit ripening, increase of valuable substances content, induction of root formation, increase of mechanical strength of tissues and most importantly increase the yield characteristics of cultivated crops. However, there is still no developed theory of directed synthesis of growth regulators of hormonal nature. The deciphering of the mechanisms of action of endogenous growth regulators is the most important task of biotechnological science. Its solution will significantly expand the opportunities for controlling plant ontogenesis and the formation of their qualitative and productive indicators, which is necessary for increasing the efficiency of agricultural production.

Keywords: hormonal preparations, growth regulators, ontogenesis, mechanisms of action, efficiency.

Introduction

Plant growth processes are largely determined by internal factors among which genetic and hormonal regulation occupies the main place. The action of two types of regulation on the plant growth is carried out both separately and jointly

causing numerous growth effects and switchings which form the basis of temporal and structural transformation of morphogenesis. In this regard, deciphering the mechanisms of action of endogenous regulators is now the most important task of the entire biological science. It provides powerful opportunities to control plant ontogenesis and crop yield formation by crops [1].

Materials and methods

Close to the first, basic, genetic level of regulation of plant ontogenesis, growth and development, there is a second, hormonal level, which is largely controlled by the first one. Formation of phytohormones, their dynamics and ratio, inactivation and degradation in plant organism have a great influence on the indicators of their growth and development processes: intensity, scale, orientation, localization as well as on the structure and quality of all morphogenetic effects [2]. Natural plant growth regulators – phytohormones (auxins, gibberellins, cytokinins, ethylene and abscisic acid) – have not been economically significant. Their production and application at the current stage of science and production development proved to be ineffective.

However, the idea of using these compounds as endogenous regulators eventually led to the mass search, synthesis and application of synthetic drugs of similar action [3]. The most famous are the so-called retardants – drugs that block the synthesis of gibberellins and inhibit plant growth. Most of them belong to the group of ethylene producers and are widely used to increase the resistance of wheat, rye and other crops to lodging. Natural and synthetic regulators of plant growth and development are also used to enhance or weaken the expression of the main properties of plants in ontogenesis, to accelerate or slow down the growth and development of plants, to ensure a uniform maturation of the crop, to improve its marketable qualities and, most importantly, to increase the resistance of plants to environmental stress factors [4].

The effect of synthetic regulators is realized by changing the endogenous level of natural phytohormones, which makes it possible to shift the growth and development of plants in the desired direction and to the desired extent [5].

From the practical point of view, L. J. Nickell's definition of plant growth regulators as natural or synthetic chemicals used to treat plants in order to change their vital processes or structure to improve their quality, increase the yield or facilitate harvesting should be considered the most accurate [6]. To this we should add the most important property of growth regulators – to cause the corresponding effects in extremely small doses, which is of great ecological importance, as well as the ability of some of them to protect plants and crops from environmental stresses and pathogens.

L. J. Nickell objectively notes that at present the attitude to the use of plant growth regulators varies in many countries from stubborn conservatism to unrestrained enthusiasm. The scale of their production and application today is inferior to that of herbicides. However, in the coming years investment in this branch of agronomic chemistry will increase rapidly, it will become the most intensively developed.

About 5 thousand compounds of chemical, microbial and plant origin possessing regulatory effect have already been created and studied to a greater or lesser extent. However, only about 50 preparations are used in the world practice so far, and in our country even less [2].

Lack of well-developed theory of directed synthesis of biologically active compounds and especially plant growth regulators leads to huge non-productive losses in their creation. According to generalized data, one out of 5–10 thousand preparations (less frequently more) turns out to be biologically, ecologically and economically efficient. The search and synthesis of new regulators of plant growth and development in our country is particularly lagging behind. The scale of this important work is dozens of times inferior to the foreign ones. In the conditions of increasing tension all over the world between the necessity of mass use of chemically active substances in agriculture, including plant growth regulators, and increasing danger of the consequences of their use for human health and ecological purity of the environment it is very important to deploy the search for nontoxic highly effective preparations and, first of all, for anti-stress action [7].

Results and discussion

The group of Kazakh preparations, providing increase of barley resistance to drought and cereals resistance to low temperatures, under the common has been created and mastered in production. It showed high efficiency. They showed high efficiency.

The role of plant growth and development regulators has increased sharply in recent years due to the widespread use of intensive cultivation technologies of grain and other crops to increase yields and lodging resistance [8]. The retardant effect of synthetic plant growth regulators on crops of wheat, rye, barley and other cereals is used practically in all European countries. Many of the world's largest companies of various specialization, such as Shell ICI, Horst and others, have deployed a large-scale search, synthesis, primary screening, testing and marketing of chemical plant growth regulators due to the expected sharp increase in their production volumes and expansion of application areas [2].

The economic profitability of the use of plant growth regulators has been proved worldwide in treating rubber trees (increase in latex yield), sugarcane (accelerates its ripening), onions and potatoes (accelerates their germination),

various crop products during storage (their storability is improved), etc. Plant growth and development regulators are also used for induction of root formation of flowering, fruit ripening, sexualization, aging of plants, etc [1, 3, 9].

All this puts the problem of natural and synthetic regulators of plant growth and development in a new way in scientific and practical terms. In Kazakhstan and other countries, a target complex scientific and technical program «Creation and widespread use of growth regulators ensuring increase in crop yields and quality of agricultural products» has been developed and is being implemented. In many scientific and educational institutions the synthesis of new regulators of growth and development of plants, their screening studying in laboratory and field conditions is conducted.

With the increase of ecological danger of the use of chemical means and the growing concern of the public about it the urgent necessity to organize permanent monitoring of the use of regulators of growth and development of plants has arisen.

The modern market offers a large number of commercial preparations of phytohormones called growth regulators. These are also preparations of the auxin group – plant growth regulators of indole nature. They have been widely used for a long time to improve the rooting of cuttings of many crops, as well as to improve their survival during transplantation, including seedlings and sprouts; in foliar treatments, the preparations stimulate the development of the plant root system [10]. Among the classical phytoregulators are also preparations containing gibberellins. This class of phytohormones includes more than 60 organic compounds, most of which are acids.

The action of gibberellins is based on the stimulation of cell division. Due to the activation of the synthesis of nucleic acids and proteins under their action, the growth of the stem is enhanced, flowering is accelerated, and the aging of leaves and fruits is delayed [11].

These are retardants, the most studied group of growth regulators, which are widely used on cereals, rapeseed and seed potatoes. The mechanism of action is based on the ability to cause an antagonistic effect on the metabolism of gibberellin, which leads to a decrease in the length of the stem, an increase in its diameter and thickening of the walls. Plants become more resistant to mechanical stress, to lodging. In the process of metabolism in plant tissues, ethylene is formed, a natural phytohormone that regulates plant growth processes, activates maturation, and takes part in the reaction of the plant organism to various stress factors.

These are analogs of the natural phytohormone-brassinosteroid, they are plant growth and development regulators with a significant adaptogenic and anti-stress effect. Brassionolides have been found to be related to the activation of the

synthesis of other phytohormones in the plant – giberellins, cytokinins and auxins, which are necessary for the growth and development of plants [11].

Conclusions

To understand the advantages and features of these products is not an easy task, and the selection of a drug for a specific crop and a specific purpose in certain climatic conditions requires special research and the task of modern science is to identify all the nuances of using these drugs and provide this information to agricultural producers.

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ӨСІМДІК ӨСУІН ЭНДОГЕНДІ РЕТТЕУ АСПЕКТІЛЕРІ

Мақала ауылшаруашылық өсімдік шаруашылығында гормоналды препараттарды қолдану аспектілеріне арналған. Өсімдік ағзасындағы өсу процестері көбінесе ішкі факторлармен анықталады, олардың арасында гормоналды реттеу басты орын алады. Өсімдіктердің өсу заңдылықтарын зерттеу ауылшаруашылық өсімдіктерінің өнімділігін модельдеу, бағдарламалау және болжау әдістерін жасау үшін қажет. Гормоналды табиғаттың өсуін реттегіштер көптеген мәселелерді шешуде өздерінің тиімділігін көрсетті: әртүрлі ауылшаруашылық және техникалық дақылдарды өсіру кезінде, мысалы, өсімдіктердің әртүрлі табиғаттағы стресс факторларына төзімділігін арттыру, өсімдіктердің қорғаныш қасиеттерін индукциялау, жыныстық қатынас, гүлдену, жемістердің пісуін тездету, құнды заттардың құрамын арттыру, тамырдың пайда болу индукциясы, тіндердің механикалық беріктігін арттыру және ең бастысы мәдени дақылдардың өнімділік сипаттамаларын арттыру. Сонымен қатар, гормоналды табиғаттың өсуін реттегіштерді бағытталған синтездеудің дамыған теориясы әлі де жоқ. Эндогенді өсу реттегіштерінің әсер ету механизмдерін ашып жазу биотехнологиялық ғылымның маңызды міндеті болып табылады. Оны шешу өсімдіктердің онтогенезін басқару және олардың сапалық және өнімді көрсеткіштерін қалыптастыру мүмкіндіктерін едәуір кеңейтеді, бұл ауылшаруашылық өндірісінің тиімділігін арттыру үшін қажет.

Кілтті сөздер: гормоналды препараттар, өсуді реттегіштер, онтогенез, әсер ету механизмдері, тиімділік.

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АСПЕКТЫ ЭНДОГЕННОЙ РЕГУЛЯЦИИ РОСТА РАСТЕНИЙ

Статья посвящена аспектам использования гормональных препаратов в сельскохозяйственном растениеводстве. Ростовые процессы в растительном организме в значительной мере детерминированы внутренними факторами, среди которых основное место занимает гормональная регуляция. Изучение закономерностей роста растений имеет важное значение для разработки методик моделирования, программирования и прогнозирования урожая сельскохозяйственных растений. Регуляторы роста гормональной природы показали свою эффективность при решении многих проблем: при выращивании разных сельскохозяйственных и технических культур, например, для повышения устойчивости растений к стрессовым факторам различной природы, индукции защитных свойств растений, сексуализации, цветения, ускорения созревания плодов, повышение содержания ценных веществ, индукции корнеобразования, повышение механической прочности тканей и главное повышение урожайных характеристик возделываемых культур. При этом до сих пор отсутствует разработанная теория направленного синтеза регуляторов роста гормональной природы. Расшифровка механизмов действия эндогенных регуляторов роста является важнейшей задачей биотехнологической науки. Решение ее значительно расширит возможности управления онтогенезом растений и формированием их качественных и продуктивных показателей, что необходимо для повышения эффективности сельскохозяйственного производства.

Ключевые слова: гормональные препараты, регуляторы роста, онтогенез, механизмы действия, эффективность.

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