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THE INFLUENCE OF AGROCHEMICALS AND BIOLOGICALLY ACTIVE SUBSTANCES ON THE GROWTH AND DEVELOPMENT OF LEGUMINOUS PLANTS IN THE EARLY STAGES OF EVOLUTION

Aysuvakova T.P., Researcher

All-Russian Research Institute of Phytopathology, Moscow Region, Russia

E-mail: vniif@vniif.ru

ABSTRACT

The problem of regulating the growth and development of legumes with the help of physiologically active substances is currently one of the most urgent in modern biology. Interest in this group of compounds is due to a wide range of their effects on plants, the ability to regulate separately the stages of growth and development in order to mobilize the potential possibilities of the plant organism, and, consequently, to increase the yield and quality of agricultural products. A large set of chemical preparations (retardants, herbicides, growth stimulators, etc.), partially already used in agriculture or under testing, requires careful study of the characteristics of their action on plants, depending on the genotype and environmental factors.

KEY WORDS

Legumes, biological active substances, growth, development, influence, pesticides.

Vegetable production is one of the main and most labor-intensive branches of agricultural production. This branch has an important role in supplying the population with food products of high biological value, containing a number of necessary components, minerals and vitamins. In modern conditions, crop yields can be increased on the basis of a high crop culture by scientifically based environmentally safe application of fertilizers and pesticides, widespread introduction of advanced technologies with minimal use of chemicals.

Legumes are one of the oldest cereals known to mankind. To legumes belong to peas, kidney beans, soybeans, chickpeas, lentils and beans. Depending on the variety and maturity, legumes include either vegetables or varieties of cereals in cooking and in trade practice. Legumes are distinguished by high taste and nutritional values. They contain 22 to 25% protein, 60 to 70% starch and 1.5 to 3% fat. Soybean seeds differ in the greatest calorific capacity, they contain up to 20% fat and 32% protein.

The yield of legumes is largely determined by the seed quality of seeds, the leading indicator of which is laboratory germination. Seed carriers of biological properties determine the quality and quantity of the crop produced to a decisive degree [5].

Seed germination is one of the most important and complex processes affecting the passage of all successive stages of development of organisms during vegetation of plants. It is characterized by intensive metabolism; stored nutrients undergo significant changes, turning into vital compounds for the body, which ensure normal growth and development of the seed bud.

One of the effective ways to preserve the beneficial properties of the legumes and to increase their yield is the use of biologically of growth-stimulating action to reduce interphase periods and increase the productivity and resistance of plants to unfavorable factors.

Legumes and their national economic importance. Legumes are one of the largest families of flowering plants, numbering about 18 thousand species. They are distributed almost over all the land of the globe accessible to flowering plants, and they are represented by the most diverse life forms - from huge trees and lianas to tiny desert plants [7]. Representatives of legumes can climb to the mountains up to 5 thousand meters of altitude, live in the Far North and in hot-arid deserts.

Legumes constitute a significant part of our flora, representing almost 10% of the species of flowering plants in Russia. These include such large genera as astragalus,

everlasting pea, deervetch, medick, sweet clover, sainfoin, locoweed, clover, vetch, etc. Among the legumes are many food crops of world significance. These include soybeans, beans, mung beans, peanuts, peas, chickpeas, lentils, English beans and many others [26]. All these useful plants man has been growing for many centuries, and in the wild they are often unknown. The nutritional value of legumes is determined by the very high content of protein, starch and fat in their seeds. A fairly large amount of protein is contained in pea seeds - up to 27%, and in lentil seeds it can reach 32%. Seeds of peanuts up to 60% consist of oil and up to 37% of protein. Legumes are quite capable of replenishing the lack of meat products. We are used to consider sunflower and hemp as the main oil-bearing crops, but much more oil is produced all over the world from peanuts. It is inferior only to cotton in this. Pulp beans of separate species, containing a large number of acids and sugars, are consumed as fruits, for example, fruits of Mediterranean carob [10]. Many tropical trees give valuable wood, painted in pink, red, dark brown and almost black tones.

A long history has the use of legumes in medicine. A number of plants, for example, Cassia and Japanese pagoda tree as medicinal products are of world importance. The thickets of Central Asian common licorice and Ural licorice have global significance [20]. The root extract is used in the medicinal and food industries. Some legumes are used for the preparation of balms, aromatic substances, gums.

The economic importance of legumes is very large, so they are cultivated in all countries of the world. Seeds of leguminous plants are rich in proteins, the content of which vary between 20-40% and exceeds, on average, twice the content of proteins in the grain of cereals. Proteins of legumes are mostly full in amino acid composition, the limiting acid is methionine.

Seeds of legumes are used for food, fodder and technical purposes. They are widely used for the preparation of soups, cereals, sauces, purees, coffee substitutes. Peas, kidney beans, lentils and beans are widely used in the canning industry. From peas and lentils can be also received cereals and flour. Flour is added to sausages and fodder concentrates. Seeds of soy and peanuts serve as good raw materials for obtaining valuable vegetable oil. Seeds of leguminous plants are a very valuable concentrated animal feed. They are used as the main components of mixed fodders [15].

Legumes give highly nutritious, protein-rich hay. Frequently they are sown with cereal grains (oats, barley), with cereal grasses (timothy grass, etc.) and are harvested during the flowering period. They give good green fodder, silage, haylage. Bean plants play an important role in the enrichment of the soil with nitrogen. On their roots, nodule bacteria develop that assimilate nitrogen from the air. Nitrogenous compounds remain in the soil with the roots odds after harvesting legumes [6, 24]. Of particular importance are legumes for countries in Asia, Central and South America, where the main food is rice, the grain of which is poor in protein. The lack of proteins in rice is compensated with proteins of leguminous plants.

The classification of biologically active substances. Biologically active substances (BAS) (from the Greek *Bios* - life, corresponds to the word «biological» and means a link to life processes, and also from the *Latin* - *Activeus* - active, ie a substance that has biological activity) is compounds that, due to their physical and chemical properties, have a certain specific activity and perform or affect, alter the catalytic (vitamins, enzymes, coenzymes), energy (lipids, carbohydrates), plastic (lipids, carbohydrates, proteins), regulate (peptides, hormones, hormone-like substances) or other function in the human body, animals or plants. The meaning of the phrase can vary significantly depending on the scope of use. In the scientific sense of the word (mental, neurophysiological, chemical processes) biologically active substances increase the activity of the basic vital processes of the organism [1].

In other words, biological action is physiological, bio-chemical, genetic and other changes that occur in the organism and living cells as a result of the action of biologically active substances [7]. For the purpose of classification, all biologically active substances are divided into endogenous and exogenous. Endogenous substances include chemical elements (potassium, hydrogen, oxygen, phosphorus, etc.), low-molecular compounds (ATP, ethanol, glucose, adrenaline, etc.) and high-molecular substances (RNA, DNA, proteins).

These compounds are part of the body, participate in the metabolic processes of substances and have a pronounced physiological (biological) activity. Exogenous are considered biologically active compounds (BAS), entering the body of plants, animals, humans in various ways [19].

Taking into account interaction with the organism, biologically active substances are divided into bioinert substances, which are practically not assimilated by the organism (hemicellulose, cellulose, organosilicon polymers, lignin, polycarbonate, etc.); biocompatible, which are slowly fermented or dissolved in the body (polyvinylpyrrolidone, polysaccharides, polyvinyl alcohol, polyacrylamide, water-soluble cellulose ethers, polyethylene oxide, etc.); bionosvemesimye, which cause irritation or necrosis of body tissue (some polyamides, polyanthracenes and many others); bioactive directional substances (vinyl polymers in combination with drugs).

All biologically active substances or individual elements that cause poisoning of animals or the normal functioning of individual body systems, depending on their intended purpose, are divided into a number of groups [18].

Pesticides (pestis - harmful, caedere – to kill). Pesticides are a means of controlling pests of plants and animals. The maintenance of modern highly productive agriculture is impossible without their application. Therefore, there is an increase in both the assortment and the volume of application of pesticides. Pesticides have not only toxicological, but also veterinary and sanitary importance, as some of them pollute environmental objects and accumulate in the tissues of animals, are released with milk and eggs, which leads to contamination by their remnants of food products of animal origin.

Mycotoxins. Mycotoxins include toxic substances (metabolites) formed by microscopic fungi (mold). Among them there are compounds possessing exceptionally high biological activity, acting extrogenically, carcinogenic, embryotoxic, gonadotoxic and teratogenic. Thus, LD of one of the fusarium metabolites from the genus *Fusarium*-T-2-toxin for white mice is 3.8 mg/kg, aflatoxin B is approximately the same toxicity. Currently, no other such compound is known to be used for plant protection or animals, with such high toxicity. LD carbofuran (furan), one of the most toxic pesticides used to treat beet seeds and not allowed to be used in animals, is 15 mg/kg, i.e. it is 4 times less toxic than T-2 toxins [12, 21].

In many countries of the world, extensive research is carried out on the isolation of mycotoxins, the study of their chemical structure, the determination of biological activity, the development of methods for determining in animals feed and tissues, the factors that influence the toxin formation process.

Toxic metals and their compounds. Among the metal compounds, mercury-, lead-, cadmium-containing substances and, to a lesser extent, chromium-, molybdenum-, zinc-containing compounds have the greatest sanitary and toxicological value.

Nitrogen compounds. Of the compounds of this group, nitrates (NO₃), nitrites (NO₂), nitrosamines and to some extent urea-carbamide [CO(NH₂)₂], have a sanitary-current-sicological significance, etc. Due to the extensive chemicalization of agriculture and the application of in the large scale of nitrogenous fertilizers, the sanitary and toxicological significance of nitrates and nitrites increases significantly, which can accumulate in significant amounts in fodder crops, especially in root crops, by adsorption from the soil [5, 26].

The influence of biologically active substances on the growth and development of legumes. An analysis of the trends in the chemicalization of world crop production shows that at the present time, the scientific and practical interest in regulators of plant growth and development is increasing. This is due to the fact that in recent years the understanding of the mechanism of action of many known growth regulators has deepened, new drugs of narrow-directed action have been created, for example activators and inhibitors of phytohormones, metabolism, photosynthesis, transpiration and other regulators.

Plant growth and development regulators are an extensive group of natural and synthetic organic compounds that, in small doses, actively influence the metabolism of higher plants. The stimulation of the plant's own immunity makes it possible to induce in plants

complex nonspecific resistance to many diseases of fungal, bacterial and viral origin and other unfavorable environmental factors (drought, temperature stress, etc.).

At this point, about 5000 compounds (of chemical, microbial and plant origin) with a regulatory effect have been discovered and studied to some extent, but in the world practice about 50 are used. This indicates that their extensive production application is just beginning. Indeed, the share of all industrial preparations of growth regulators in the world market of agrochemicals is currently about 10%. However, in terms of the expansion of production, sales and use, growth regulators outperform all other chemicals that are used in world agriculture. The mechanism of action of biological preparations is described in the literature, which consists in the activation of mycorrhizal and endomycorrhizal plant fungi. In the analysis of agronomists it is noted that regulators of plant growth and development contribute to an increase in the yield of agricultural crops by 15-30% using a smaller amount of mineral fertilizers, normalizing the mineral composition of plant biomass, and reducing crop losses from diseases.

The main distinguishing feature of the preparations of this group from other plant protection products is the ability to influence harmful organisms by stimulating the protective properties of plants incorporated in them during evolution. The use of this feature in crop production practice allows to realize the potential of integrated plant protection programs to the fullest extent, ensuring maximum environmentalization of agro-systems.

Plant growth regulators or stimulants (PGRs) are natural or synthetic substances that stimulate the growth and development of plants by accelerating the division of cells or their extension in length. Phytohormones - auxins, gibberellins, cytokinins, and synthetic ones - are their natural stimulators for plant growth. Plant growth regulators are successfully used to eliminate the periodicity of fruiting, acceleration of flowering and ripening of fruits. Experience shows that in order to obtain a high effect, growth regulators should be used at different stages of plant growth and development, especially since each preparation has its own «specialization». The culture of plant growth-stimulating drugs in private farms, unfortunately, is not yet available. This, apparently, is due to the lack of professional agrochemical knowledge among the population, since unlike private traders, all industrial farmers actively use growth stimulants.

The use of drugs that stimulate plant growth leads to an increase in yield by 20-30%. At the same time, in value terms, growth stimulants are the cheapest of all plant protection products sold. Plant growth regulators make it possible to strengthen or weaken the characteristics and properties of plants within the norm of the reaction determined by the genotype, heredity. They are an integral part of the complex chemization of plant growing. With their help, shortcomings of varieties and hybrids are compensated, which is why they are one of the important elements of modern technologies aimed at increasing the productivity of agricultural crops. Growth regulators include both natural and synthetic compounds that actively influence metabolism. The result of their application leads to visible changes in the growth and development of plants. The regulation of physiological processes by hormones or their synthetic analogs is very specific and cannot be accomplished by other means of influencing plants. Growth regulators have a wide range of effects on plants: accelerate maturation, increase productivity and improve the quality of crop yields, and also reduce the negative impact of unfavorable environmental factors.

At present, there are eight groups of phytohormones, five of which belong to the classical (auxins, gibberellins, cytokinins, abscisic acid, ethylene) and three are relatively recently discovered - brassinosteroids, jasmine and salicylic acids. The discovery of a new phytohormone is a very rare event. Phytohormones are usually synthesized in plants in very small quantities from the products of photosynthesis and glycolysis. It should be noted that phytohormones participate in the regulation of metabolism at all stages of plant life - from the development of the embryo to the complete completion of the life cycle and death. They determine the nature of the growth and development of plants, the formation of new organs, habitus, flowering, aging of the vegetative parts, the transition to rest and escape from it. Phytohormones influence the growth and division of cells, the processes of adaptation to aging, the transport of matter, respiration, the synthesis of nucleic acids and proteins, and

many other processes. However, each group of these substances has its own specific features.

Representatives of classical phytohormones are auxins. They are widespread in plants. The most abundant are growing parts: the tips of the stem and root, young leaves, developing seeds and pollen. They are formed in the meristematic (educational) tissues of the stem or root, but in the tips of the stems they are synthesized more than in the roots. The supply of plants with auxins depends on their supply of water and nutrients. Auxins in plants are contained in very small quantities. However, these quantities of the hormone are quite enough to provide the most diverse processes of vital activity of the plant organism. Auxins regulate a number of growth and formative processes. They participate in the laying of vegetative buds and roots, in the germination of pollen, in the growth of the ovary and in the growth of fruits, in the formation and germination of seeds, affect the distribution of nutrients, prevent the loss of fruits and leaves.

The second group includes gibberellins, which are synthesized mainly in leaves and stimulate vegetative growth of the plant, activating the processes of cell stretching and division, accelerate the germination of seeds, initiate the flowering of certain plant groups under non-inductive conditions, promote the formation of parthenocarpic fruits, males, activate the activity of many, especially hydrolytic enzymes.

The third group is represented by cytokinins, which in plants are formed in the roots. Together with the current of water, they move around the cells and spread throughout the plant. They are present there in extremely small quantities, the developing seeds are the most abundant in them. Another surprising property of cytokinins is known - to delay the aging process. In addition to this property, they give impetus to the differentiation of tissues, intensify the effect of light on the growth of shoots and the laying of buds, accelerate the germination of seeds, interrupt the resting period of sleeping buds, tubers, arrest the apex dominance and stimulate the growth of the lateral (axillary) kidneys, cause the opening of stomata.

The gaseous substance ethylene possesses the same properties that help the plant balance well the stimulating and inhibiting processes. It is formed in the leaves of many plants, and is also isolated as a metabolite in flowers. The ethylene present in the plants inhibits cell division and contributes to the aging of the tissues, as a result of which leaves and generative organs fall off, induces fruit ripening. Processing plants with ethylene, you can accelerate the dropping of leaves, stimulate flowering and maturation, cause the appearance of roots and their reorientation, the formation of roots with a large number of sleeping buds, suppress the elongation of shoots and roots, change the ratio of female and male flowers towards the formation of women. Absciscic acid is often called a «restorer». This is due to the fact that, accumulating in the seeds of ripening fruits, in the skin of dormant tubers, in autumn buds of plants, it is able to suppress growth processes - germination of seeds and tubers, bud budding, root formation, stalk growth. However, the role of absciscic acid is reduced not only to inhibition of certain vital processes of the plant organism. In low concentrations, it can stimulate root formation, growth by stretching, etc. Therefore, a number of authors consider it to be phytohormones. In the plant there is a complex interaction between individual hormones. They affect the synthesis, decay and transport of each other. A change in the level of one of the components of the phytohormonal system inevitably leads to a change in the entire system. Thus, without taking into account the mutual influence of phytohormones, it is very difficult to decide uniquely the question of the specificity of their action [16, 24].

The data of domestic and foreign science and practice testify to the successful use of physical and chemical factors of influence as means of controlling the vital activity of plants.

The problem of regulating the growth and development of plants with the help of physiologically active substances is currently one of the most urgent in modern biology. Interest in this group of compounds is due to a wide range of their effects on plants, the ability to regulate separately the stages of growth and development in order to mobilize the potential possibilities of the plant organism, and, consequently, to increase the yield and quality of agricultural products. A large set of chemical preparations (retardants, herbicides,

growth stimulators, etc.), partially already used in agriculture or under testing, requires careful study of the characteristics of their action on plants, depending on the genotype and environmental factors.

As many studies have shown, the effectiveness of various chemicals is largely determined by the susceptibility of not only individual species, but also varieties of cultivated plants. The mechanism of action of the growth regulator is based on the activation of the protein-synthesizing system. Under its influence, a decrease in the index of peroxide oxidation of membrane lipids was established, which is controlled by nuclear and cytoplasmic genes. In plant roots accelerates the mitotic division of cells. Increases the germination energy and field germination of seeds, the resistance of plants to diseases (brown rust, root rot, etc.) and stress factors (high and low temperatures, drought, phytotoxic action of pesticides), increases yield and improves product quality [9, 23].

Given the urgency of the problem of using growth regulators in the cultivation of perennial legumes, scientists conducted studies on the effectiveness of regulators. As a result of the studies, a positive reaction of plants to the tested growth regulators was established and their optimal doses were determined.

CONCLUSION

The use of perspective ways and methods to increase the yield and quality of seeds of leguminous crops is the most important task in the current conditions of agriculture. Modern varieties and hybrids of legumes have a high potential for productivity and for more effective ways to increase the agricultural sector of the economy from an ecological point of view, the practice of plant-growing should include the method of presowing seed treatment with microelements and growth regulators that cause activation of the metabolic- processes in the plant organism in extremely small doses, are able to protect the plant from stress and pathogen effects, which is very important for the formation of the crop

At the present day, the role of research on the development of adaptive technologies for cultivating crops with a high yield level, creating optimal conditions for legume-rhizobia symbiosis, increasing plant resistance to unfavorable environmental factors, decreasing the pesticide load and improving the mineral nutrition of macro- and microelements. At the same time, complex studies using trace elements, growth regulators and biologically active substances of natural origin for processing seeds of agricultural crops were insufficiently conducted. In-depth study of this direction is necessary to justify energy-saving technologies for the production of high-quality agricultural products and their wide application in production. This problem has an extremely topical significance in practical plant growing with the purpose of effective application of mineral fertilizers with the identification of antagonism, synergism, additivity and interaction coefficients in ontogenesis of plants.

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