SCIENTIFIC AND PRACTICAL FOUNDATIONS FOR THE DEVELOPMENT OF TECHNOLOGY FOR PRODUCING A DEFOLIANT BASED ON MAGNESIUM SULFATE AND ITS APPLICATION IN AGRICULTURE

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Abstract. This scientific article comprehensively examines the issues of improving the technology for producing a defoliant based on magnesium sulfate and introducing it into agricultural practice. The study provides an in-depth analysis of the physiological and biochemical mechanisms of the defoliation process, the effects of magnesium sulfate on the plant organism, the stages of defoliant production technology, as well as environmental and medical-hygienic safety aspects. The obtained results indicate that magnesium sulfate–based defoliants are highly effective, low in toxicity, and suitable for sustainable agricultural systems.

Keywords: defoliant, magnesium sulfate, defoliation, plant physiology, agrochemistry, environmental safety.

Annotatsiya. Ushbu ilmiy maqolada magniy sulfat asosidagi defoliant ishlab chiqarish texnologiyasini takomillashtirish va qishloq xo‘jaligi amaliyotiga joriy etish masalalari har tomonlama ko‘rib chiqilgan. Tadqiqotda defoliatsiya jarayonining fiziologik va biokimyoviy mexanizmlari, magniy sulfatining o‘simlik organizmiga ta’siri, defoliant ishlab chiqarish texnologiyasi bosqichlari, shuningdek, ekologik va tibbiy-gigiyenik xavfsizlik masalalari chuqur tahlil qilingan. Olingan natijalar magniy sulfat asosidagi defoliantlar yuqori samarali, toksikligi past va barqaror qishloq xo'jaligi tizimlari uchun mos ekanligini ko'rsatadi.

Kalit so'zlar: defoliant, magniy sulfat, defoliatsiya, o'simliklar fiziologiyasi, agrokimyo, ekologik xavfsizlik.

Аннотация. В данной научной статье всесторонне рассматриваются вопросы совершенствования технологии производства дефолианта на основе сульфата магния и его внедрения в сельскохозяйственную практику. Исследование содержит углубленный анализ физиологических и биохимических механизмов процесса дефолиации, воздействия сульфата магния на растительный организм, этапов технологии производства дефолианта, а также аспектов экологической и медико-гигиенической безопасности. Полученные результаты показывают, что дефолианты на

ISSN 3030-3907

основе сульфата магния обладают высокой эффективностью, низкой токсичностью и пригодны для устойчивых систем земледелия.

Ключевые слова: дефолиант, сульфат магния, дефолиация, физиология растений, агрохимия, экологическая безопасность.

INTRODUCTION.

In modern agricultural production, achieving high yields, improving product quality, and mechanizing production processes are considered among the most important strategic objectives. In particular, in cotton farming, harvesting the crop within a short period and with minimal losses is one of the key factors determining production efficiency.

During mechanized cotton harvesting, the presence of leaves interferes with the operation of machinery, causes foreign impurities to adhere to the fiber, and reduces product quality. Therefore, the defoliation process is widely applied in cotton cultivation as an important agrotechnical practice.

However, some chemical agents used in defoliation are characterized by high toxicity, long-term persistence in soil and water environments, and adverse effects on human health, which creates serious challenges. From this perspective, the development of environmentally safe, economically efficient, and biologically adaptable defoliants is of great relevance. Defoliants based on magnesium sulfate are regarded as promising agents that meet these requirements.

MAIN PART

1. Theoretical, Physiological, and Agrotechnical Foundations of the Defoliation Process

Defoliation is a process that ensures the shedding of plant leaves by artificially limiting or completely suppressing their physiological activity. During this process, photosynthetic activity in the leaves sharply decreases, transpiration is disrupted, and water and metabolite exchange within plant cells is impaired.

In the plant organism, vegetative and generative developmental processes normally exist in a state of balance. As a result of defoliation, the activity of vegetative organs declines, and energy as well as nutrients within the plant are redirected toward generative organs, namely fruits and fiber. This, in turn, leads to accelerated crop maturation and more uniform boll opening.

From an agrotechnical perspective, the effectiveness of defoliation depends on several factors, including the type of defoliant, its concentration, the timing of application, weather conditions, and the developmental stage of the plant. Scientifically grounded selection and optimization of these factors ensure high efficiency and favorable outcomes of the defoliation process.

2. Chemical, Biological, and Physiological Properties of Magnesium Sulfate

ISSN 3030-3907

Magnesium sulfate is an inorganic salt that is highly soluble in water and consists of magnesium and sulfate ions. Magnesium is an essential macronutrient in plant life processes. It serves as the central element of the chlorophyll molecule and ensures the normal progression of the photosynthesis process.

When magnesium sulfate is used as a defoliant, its effect is expressed in a concentration-dependent manner. At high concentrations, osmotic pressure in leaf cells increases sharply, water is withdrawn from the cells, and cellular metabolism is disrupted. As a result, leaves rapidly turn yellow, dry out, and abscise.

An important feature of magnesium sulfate is that it exerts a strong effect on leaves while having a relatively mild impact on stems and generative organs. This characteristic makes it possible to preserve crop quality indicators. From a biological perspective, magnesium sulfate decomposes rapidly in the soil and does not exert long-term adverse effects on the environment.

3. Scientific Analysis of the Technology for Producing a Magnesium Sulfate–Based Defoliant

The technology for producing a defoliant based on magnesium sulfate consists of simple and efficient processes. Initially, technically pure magnesium sulfate raw material is selected and subjected to quality control based on its physicochemical parameters. In the next stage, it is dissolved in water at a predetermined concentration.

To ensure the homogeneity of the solution, mixing and homogenization processes are carried out. The addition of surfactants enhances uniform adhesion of the defoliant solution to the leaf surface and increases its effectiveness. During the technological process, parameters such as pH, temperature, and density are continuously monitored.

Below is a generalized scientific and technological characterization of magnesium sulfate–based defoliants.

ISSN 3030-3907

Table 1.

Scientific and Technological Characteristics of Magnesium Sulfate–Based Defoliants

Parameters
Description
Chemical formula
$MgSO_4 \cdot nH_2O$
Physical state
White crystalline substance
Solubility in water
Very high
Defoliation mechanism
Increases osmotic pressure
Leaf abscission period
5–10 days
Effect on photosynthesis
Strongly suppresses
Effect on the plant
Strong effect on leaves, mild effect on fruits
Persistence in soil
Does not persist for a long time
Environmental safety
High
Toxicity level
Low
Sanitary-hygienic assessment
Moderately safe
Practical application
Cotton cultivation

4. Environmental, Sanitary-Hygienic, and Medical Assessment of Defoliants

Defoliants based on magnesium sulfate are considered relatively environmentally safe. They decompose rapidly in soil and aquatic environments, do not form harmful residual substances, and do not disrupt the stability of agroecosystems.

ISSN 3030-3907

From a sanitary-hygienic perspective, magnesium sulfate is a low-toxicity substance and does not pose a serious risk to human health when applied at recommended rates. The widespread use of magnesium sulfate in medical practice confirms its biological compatibility and safety.

CONCLUSION. The conducted scientific analyses demonstrate that the technology for producing defoliants based on magnesium sulfate is characterized by high efficiency, environmental sustainability, and sanitary-hygienic safety. The use of these defoliants in cotton cultivation contributes to improving crop quality, ensuring efficient mechanized harvesting, and protecting the environment.

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ISSN 3030-3907