СЕКЦІЯ 5 – РОЗРОБКА СУЧАСНИХ ЕКОЛОГІЧНИХ ТЕХНОЛОГІЙ ТА ІНЖЕНЕРНИХ ЗАСОБІВ ЗАХИСТУ ДОВКІЛЛЯ. ІННОВАЦІЙНІ ПРИРОДООХОРОННІ ТЕХНОЛОГІЇ. ТЕХНОЛОГІЇ ПІДВИЩЕННЯ РОДЮЧОСТІ ҐРУНТІВ, ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ ВОДИ, ЕНЕРГІЇ, МАТЕРІАЛІВ, СИРОВИНИ. ОРГАНІЧНЕ ЗЕМЛЕРОБСТВО ТА ЕКОЛОГІЧНО ЧИСТІ ПРОДУКТИ. ЕКОЛОГІЧНА БЕЗПЕКА УКРАЇНИ ДЛЯ СИТУАЦІЙ ПРИРОДНОГО, ТЕХНОГЕННОГО, СОЦІАЛЬНО-ПОЛІТИЧНОГО І ВІЙСЬКОВОГО ХАРАКТЕРУ ТА ПРОГНОЗУВАННЯ РИЗИКІВ В КОНТЕКСТІ СТАЛОГО РОЗВИТКУ

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PERSPECTIVE ISOLATES OF ALFALFA RHIZOBIA FOR THE DEVELOPMENT OF BIOLOGICAL PREPARATIONS

Abstract. It is still important to note that in modern intensive farming systems, pre-sowing inoculation of legume seeds with bacterial suspensions of suitable rhizobia is a necessary technique to solve the problems of nitrogen deficiency and obtain stable high yields. And it is important to conduct a regular search for effective nitrogen-fixing legume nodule bacteria. The object of the study was strains of alfalfa nodule bacteria isolated from the nodules of sowing alfalfa (Medicago sativa).
Key words: nodule bacteria, alfalfa, nitrogen fixation, microbial preparations

Alfalfa is a traditional fodder crop for Ukraine and has a long history of use in different regions of the world. It is believed that for the optimal production of complete plant-based fodder, the share of long-term legumes and legume-cereal mixtures in the structure of fodder crops in Ukraine should be increased to 45-50% in the Forest-Steppe, 40-45% in the Steppe and 50-55% in Polissya. At the same time, special focus should be directed to perennial legumes, in particular, to seed alfalfa (Medicago sativa), the use of which in the coming years will increase the fertility of arable land and may become the main sustainable development stabilizer for fodder production and an integral part of biologization and ecological improvement of agroecosystems.

Alfalfa is grown to produce high-quality and balanced protein and vitamin fodder. It is a kind of soil sanitizer, protects the soil from the harmful effects of water and wind erosion, and improves the properties of saline lands. As a member of the legume family (*Fabaceae*), alfalfa is an excellent precursor for many agricultural plants, allowing it to fix 250-300 kg/ha of atmospheric nitrogen per year, thus improving soil fertility and increasing the yield of crops following in the crop rotation. A prerequisite for the formation of a nitrogen-fixing system with nodule bacteria by alfalfa is the presence of nodule bacteria specific to it in the soil. However, the native races of these microorganisms do not always form effective symbiotic relationships with plants and thus do not ensure the full realization of the nitrogen-fixing potential of alfalfa. Therefore, an important agrotechnical measure in the cultivation of this crop is the pre-

sowing inoculation of seeds with nodule bacteria, which allows the formation of mutually beneficial legume-rhizobial systems and increases the productivity of biological nitrogen assimilation by 2 or more times [1]. As a result of mutually beneficial coexistence with bacteria, plants not only acquire the ability to fix molecular nitrogen in the atmosphere but also become more resistant to negative environmental conditions. Among biological products for crop production, inoculants for legumes are the most widely used. This group of products is based on nodule bacteria that form a symbiosis with legumes through the formation of nitrogen-fixing nodules on their roots.

It is still relevant that in modern intensive farming systems, pre-sowing inoculation of legume seeds with bacterial suspensions of appropriate rhizobia is a mandatory technique, without which it is impossible to solve the problems of nitrogen deficiency and obtain stable high yields. And it is important to conduct a constant search for effective nitrogen-fixing nodule bacteria of legumes. A necessary condition for alfalfa to form a nitrogen-fixing system with nodule bacteria is the presence of nodule bacteria specific to it in the soil. However, native races of these microorganisms do not always form effective symbiotic relationships with plants. So, an important agrotechnical measure in the cultivation of this crop is the pre-sowing inoculation of seeds with nodule bacteria, which allows the formation of mutually beneficial legume-rhizobial systems and increases the productivity of biological nitrogen assimilation. As a result of mutually beneficial coexistence with bacteria, plants are not only able to fix molecular nitrogen in the atmosphere but are also resistant to negative environmental conditions. The aim of the study was the formation of legume-rhizobial symbiosis by the selected strains of Sinorhizobium meliloti.

The soil samples were taken from the experimental field of the Skvyra Experimental Station of Organic Production of the Institute of Agroecology and Environmental Management of the National Academy of Agrarian Sciences of Ukraine in Skvyra in 2019-2020. The soil on the experimental plot is typical black soil, deep medium loamy on carbonate loess, with a soil solution reaction close to neutral (pH=6.65), which is favourable for growing most crops. The search and selection of effective strains of alfalfa rhizobia were carried out using conventional methods of analytical selection on a plot of fallow land that had not been used for crops for many years [2]. The determination of the main physiological and biochemical properties of the isolates was carried out according to generally accepted methods and by the identification features of the Bergey's identifier [3].

In this way, during the growing season, we selected plants and searched for nodules formed by local soil bacteria to further study their properties. We carried out their step-by-step purification, isolation into the pure culture, identification, determination of nodulation capacity, and evaluation of nitrogenase activity of nodules formed by Sinorhizobium meliloti isolates on the roots of alfalfa plants. To confirm the species affiliation of the isolates obtained, which were virulent, their morphological, cultural, physiological and biochemical properties were determined in the laboratory. During the growing season, we selected and isolated 18 bacterial strains.

Only two strains, ML-4 and ML-12, were selected for further research. Batch culturing of the isolates in liquid MDA confirmed their belonging to fast-growing bacteria. Studies have shown that the bacterial titer of the studied strains when growing in a medium was 6.5 and 9.5 billion/ml, respectively. One of the most important characteristics of preparations based on nodule bacteria is the preservation of their nodulation activity. When the newly produced preparations were applied, all plants had nodules on their roots. The largest number of nodules, on average 38-51 per root alfalfa plant, was formed by *Sinorhizobium meliloti* strains ML-4 and ML-12, which were among the most active in the previous model experiment on agar substrate (Fig. 1).

Under artificial inoculation with *S. meliloti* ML-4 and ML-12 strain of alfalfa seeds of Plateau variety no decrease in nodulation level was observed, but nodules of the experimental variant were large, elongated, located in the basal part of the root, had pink color. On non-inoculated plants, more nodules were formed, but much smaller, which were located diffusely throughout the root system. Artificial inoculation contributed to an increase in root length by 10%, but an increase in the number of lateral roots.

In the tillering phase, differences in the growth and development of plants inoculated with the two isolated strains were observed. The total dry weight of plants inoculated with Sinorhizobium meliloti ML-4 and ML-12 strains increased by1.4-1.2 times compared to the control plants, respectively. Inoculation of alfalfa seeds with Sinorhizobium meliloti strains increased plant tillering by 30-41%.

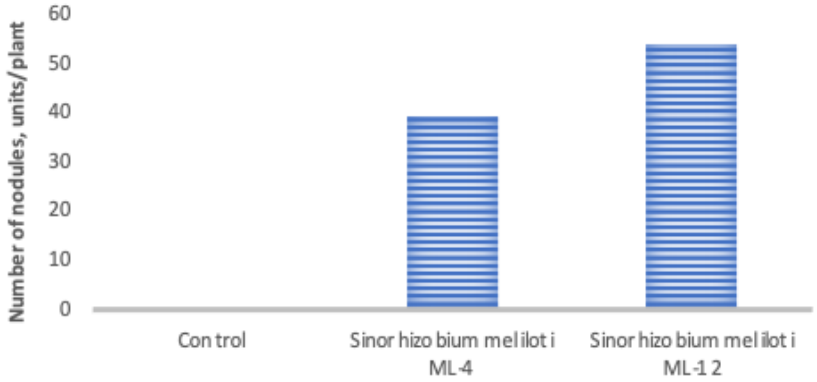

Fig. 1. **Nodulation activity of new strains of *Sinorhizobium meliloti* on roots of alfalfa variety Plateau**

Fixation of atmospheric nitrogen in symbiosis with legumes is an energy-intensive process that occurs due to solar energy accumulated during photosynthesis. The intensity of photosynthesis and symbiotic nitrogen fixation are two interrelated processes: as the supply of nitrogen to plants improves, the intensity of photosynthesis increases, and as photosynthesis intensifies, the volume of nitrogen fixation increases. A better supply of biologically bound nitrogen and better use of solar energy increases the yield of legumes.

Consequently, thanks to the research, the alfalfa nodule bacteria strains *Sinorhizobium meliloti* ML-4 and ML-12 can be used as bioagents in modern biological products.

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INVESTIGATION CHANGES IN PARAMETERS OF TECHNOLOGICAL MODES OF WATER TREATMENT FOR THE RECIRCULATING COOLING SYSTEM

Abstract. The recirculating cooling system (RCS) of power plants requires a significant amount of high-quality water, which is achieved by using water treatment methods. The study shows changes in water quality indicators during water treatment by lime softening and anti-scale treatment for RCS Rivne NPP.

Key words: particle size distribution, lime softening, HEDP, sulfuric acid.

Mineral scale, caused by hardness cations on the surface of any material in contact with water, often causes serious technical and economic consequences in domestic, municipal and industrial water supply systems [1]. The quality of water treatment in the power industry affects the reliability, economy, and