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Svetlana OKRUSHKO
Candidate of Agricultural Sciences, Associate Professor, Associate Professor at the Department of Botany, Genetics and Plant Protection, Vinnytsia National Agrarian University, Sonyachna Street, 3, Vinnytsia, Ukraine, 21008 (svitlanaokruzko@gmail.com)
ORCID: *0000-0002-9610-9830*
SCOPUS: *5804215010*

Pavlo VERHELES
Candidate of Agricultural Sciences, Associate Professor, Associate Professor at the Department of Botany, Genetics and Plant Protection, Vinnytsia National Agrarian University, Sonyachna Street, 3, Vinnytsia, Ukraine, 21008 (pasha425@gmail.com)
ORCID: *0000-0002-4101-1465*
SCOPUS: *58156184700*

Liudmyla YAKOVETS
Candidate of Agricultural Sciences, Associate Professor, Associate Professor at the Department of Botany, Genetics and Plant Protection, Vinnytsia National Agrarian University, Sonyachna Street, 3, Vinnytsia, Ukraine, 21008 (ludmila28334@gmail.com)
ORCID: *0000-0001-5283-7169*
SCOPUS: *57882068200*

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THE EFFECT OF AQUEOUS EXTRACTS FROM *ELYMUS REPENS* L. RHIZOMES ON THE GERMINATION OF CORN SEEDS

Actuality. *The conditions for plant growth and development in phytocenoses are determined not only by the level of soil fertility and weather factors, but they also significantly depend on the chemicals released into the environment by neighboring species. The chemical interaction of cultivated plants and weeds in agrophytocenoses is a complex problem that requires detailed study. As a medicinal plant, creeping wheatgrass is widely recommended in folk and official medicine. But its presence on agricultural lands leads to a decrease in the yield of cultivated plants due to the toxicity of the excretions.*

The aim of the study. To consider the effect of water-soluble extracts from the rhizomes of Elymus repens L. at different concentrations on the germination processes of corn seeds.

Material and methods. *The rhizomes of creeping pyrium were selected in the autumn after the end of the growing season. The experimental material was dried to air-dry state and crushed into particles 3–4 mm in size. For extraction, a weighted portion of the rhizome of Elymus repens L. (0,5, 1 and 10 g) was transferred to a glass container and added 100 ml of distilled room temperature. The process of extraction according to the technique lasted 1 day in the temperature of +20 °C.*

Research results. *Water-soluble secretions from the rhizomes of Elymus repens L. inhibit the germination energy of corn seeds regardless of their concentration level. There was a suppression of the length of the germinal root of corn from 2,38 cm to 3,86 cm in the experimental variants on the fourth day. The total length of the root system was shorter by 40,7–68,5% on the 7th day. Aqueous extracts from the rhizomes of Elymus repens L. inhibited the growth of corn stalks from 27,3 to 30,9% compared to the control option, where the seeds were germinated in distilled water. An aqueous extract with a concentration of 1:1 000 had a stimulating effect on germination and further growth of corn seedlings. The inhibitory effect was decreasing within 5–11 days of the germination of corn seeds depending on the concentration of allelopathically active substances of Elymus repens L. in an aqueous solution.*

Conclusion. *Aqueous extracts of Elymus repens L. rhizomes in a concentration of 1:100; 1:50; 1:20 and 1:10 have a negative effect on the germination of corn seeds. They inhibit the growth of the germinal root from 20,5% (1:100) to 74,9% (1:10), and subsequently, the stem from 27,3 to 30,9%.*

Key words: *Elymus repens L., water-soluble secretions, corn, seed germination, suppression, stimulation.*

Світлана ОКРУШКО
кандидат сільськогосподарських наук, доцент, доцент кафедри ботаніки, генетики та захисту рослин, Вінницький національний аграрний університет, вул. Сонячна, 3, м. Вінниця, Україна, 21008 (svitlanaokruzko@gmail.com)
ORCID: *0000-0002-9610-9830*
SCOPUS: *5804215010*

Павло ВЕРГЕЛЕС
кандидат сільськогосподарських наук, доцент, доцент кафедри ботаніки, генетики та захисту рослин, Вінницький національний аграрний університет, вул. Сонячна, 3, м. Вінниця, Україна, 21008 (pasha425@gmail.com)
ORCID: *0000-0002-4101-1465*
SCOPUS: *58156184700*

Людмила ЯКОВЕЦЬ
кандидат сільськогосподарських наук, доцент, доцент кафедри ботаніки, генетики та захисту рослин, Вінницький національний аграрний університет, вул. Сонячна, 3, м. Вінниця, Україна, 21008 (ludmila28334@gmail.com)
ORCID: *0000-0001-5283-7169*
SCOPUS: *57882068200*

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ВПЛИВ ВОДНИХ ЕКСТРАКТІВ КОРЕНЕВИЩ *ELYMUS REPENS* L. НА ПРОРОСТАННЯ НАСІННЯ КУКУРУДЗИ

Актуальність. *Умови росту й розвитку рослин у фітоценозах визначаються не лише рівнем родючості ґрунту та погодними чинниками, вони істотно залежать і від хімічних речовин, що виділяють у довкілля сусідні види. Хімічна взаємодія культурних рослин і бур'янів в агрофітоценозах є складною проблемою, що потребує детального вивчення. Як лікарська рослина пирій повзучий широко рекомендується в народній і офіційній медицині. Але його наявність на сільськогосподарських угіддях веде до зниження врожайності культурних рослин, через токсичність виділень.*

Мета дослідження *– розглянути вплив водорозчинних виділень із кореневищ Elymus repens L. за різної концентрації на процеси проростання насіння кукурудзи.*

Матеріал і методи. *Кореневища пирію повзучого відбиралися в осінню пору, після завершення вегетаційного сезону. Дослідний матеріал висушували до повітряно-сухого стану й подрібнювали на частинки розміром 3–4 мм. Для екстрагування зважену порцію кореневища Elymus repens L (0,5, 1 та 10 г) переносили у скляну ємність і додавали 100 мл дистильованої води кімнатної температури. Процес екстрагування згідно з методикою тривав 1 добу за температурного режиму +20 °С.*

Результати дослідження. *Відбулося пригнічення довжини зародкового корінця кукурудзи із 2,38 до 3,86 см в дослідних варіантах на четверту добу. Загальна довжина кореневої системи на сьому добу була меншою на 40,7–68,5%. Водні витяжки з кореневищ Elymus repens L. пригнічували ріст стебел кукурудзи від 27,3 до 30,9% порівняно з контрольним варіантом, де насіння пророщували в дистильованій воді. Водний екстракт концентрацією 1:1 000 чинив стимулюючу дію на проростання та подальший ріст сходів кукурудзи. Інгібуючий ефект зменшувався протягом 5–11 діб після проростання насіння кукурудзи залежно від концентрації алелопатично активних речовин Elumus repens L. у водному розчині.*

Висновок. *Водні екстракти кореневищ Elymus repens L. у концентрації 1:100; 1:50; 1:20 і 1:10 негативно впливають на схожість насіння кукурудзи. Вони пригнічують ріст зародкового корінця із 20,5% (1:100) до 74,9% (1:10), а згодом і стебла, із 27,3 до 30,9%.*

Ключові слова: *Elymus repens L., водорозчинні виділення, кукурудза, проростання насіння, пригнічення, стимуляція.*

Introduction. Actuality. Corn is characterized by the highest level of potential productivity among cereals. However, it has a very low competitive ability to weed. Corn seeds are placed in the soil where the vegetative and generative organs of the weeds are located. Perennial weeds are particularly dangerous in terms of allelopathic effects on crops. Weeds, classified as perennials, contain a large supply of nutrients in their underground organs. They form a significant vegetative mass that is a threat to the normal growth of crops throughout the growing season and after their death and decomposition. Therefore, couch grass (*Elymus repens* L. or *Agropirum repens* L.) as a noxious and common weed in Ukraine was chosen for a detailed study of phytocompetition in order to evaluate its effect on the germination of corn seeds. The allelopathic pressure of *Elymus repens* L.

at the stage of crop seed germination has not been sufficiently studied. Thus, this issue is researched in this scientific work using the example of corn.

The allelopathic effect of some plants on others occurs when physiologically active substances accumulate in their environment. These substances are released by plants during their vital activity. Avoiding or reducing the inhibitory effect of weed allelochemicals on crop seedlings can provide them with favorable starting conditions for controlling phytosanitary conditions in agrocenoses. The interaction of different types of plants is either positive if one species secretes a substance that stimulates the growth and development of another or negative if the interaction has an inhibitory (suppressive) nature (Kong et al., 2019; Schandry & Becker, 2020; Tsytsiura, 2021). Cases of negative chemical effects of weeds on crops are most often found in the agricultural sector. The degree of negative impact of certain types of weeds mainly depends on the toxicity of their secretions for crops.

(Georgieva et al., 2021) consider that cultivation of varieties tolerant to allelopathic compounds is a promising addition to the current strategy of weed control, especially in organic production.

It is well known that the prevalence of weeds among agricultural crops causes a significant decrease in the height of crops and their lower productivity. Co-growth of unwanted vegetation with crops and their above-ground physical interactions have been studied to a sufficient extent. However, the chemical impact of weeds on crops, their effects of intra-life and post-mortem secretions should be considered in more detail, taking into account the latest scientific reports on the high level of allelopathic pressure (Tsytsiura & Sampietro, 2024; Sahrir et al., 2023). According to Tsytsiura (2022), all agricultural measures should be aimed at removing allelopathic stress by inactivating toxic substances by chemical methods, by selecting tolerant plants capable of metabolizing, binding or neutralizing them with the products of their secretions.

Biologically active substances have a stimulating, neutral, or inhibitory effect, depending on the level of concentration, chemical composition, and other factors (Fozia et al., 2020; Shah et al., 2022).

The aim of the study – study of the effect of different concentrations of water-soluble allelopathically active substances from wheatgrass rhizomes on the germination of corn seeds.

Materials and research methods. The research material was aqueous extracts of different concentrations from the rhizomes of *Elymus repens* L. and corn seeds. Rhizomes of *Elymus repens* L. were selected when the largest number of substances accumulated in them, that is, after the end of the growing season. For the experiment, corn grain of the Kremin 200 SV hybrid was selected.

Coach grass rhizome contains polysaccharide triticin (up to 10%), mucilage (up to 10%), fructose (up to 4%), mannitol (up to 3%), mesoinositol, levulose, phenolic compound avenin, fatty (1,5%) and essential oil, triterpene, agronirene, malic acid; vitamin C (up to 156 mg%), carotene (up to 85 mg%), silicic acid and other substances (Medicinal plants …).

Aqueous extracts from its rhizomes were obtained in accordance with methodical recommendations (Manufacturing requirements …). The material was dried and crushed into 3-4 mm particles. A weighed portion of the rhizome of the weed was transferred to glass containers and 100 ml of distilled water at room temperature was added for extraction. For better contact of the raw material with water, stirring was carried out with a glass rod for 1 min. Containers were kept in a boiling water bath (100°C) for 15 minutes, followed by cooling for 45 minutes. The extracted solution was filtered from the plant mass after one day. Germination was carried out in 4 repetitions using 10 corn seeds belonging to a single sowing fraction under a thermostat regime with a temperature of + 22 °C. Experiments were carried out with aqueous extracts of wheatgrass at a concentration of 1:1 000; 1:100; 1:50; 1:20 and 1:10. 7 ml of distilled water (for the control variant) or aqueous extract of the appropriate concentration (for experimental variants) were placed in each Petri dish to the seeds. Another 3 ml of water or extract was added on the fourth day. Indicators of the energy of seed germination on all experimental variants were determined on the 4th day, and the germination dynamics were determined up to the 11th day with a 24-hour interval after placing the Petri dishes in the thermostat. The obtained results, were compared with the control results, where seeds were germinated in distilled water.

The statistical analysis of the data was carried out by calculating the arithmetic mean (x) ± standard deviation (SD) for each variant.

Corn grows slowly in the initial stages, so weeds have the opportunity to occupy a significant area and suppress the crop. Nowadays the problem of segetal vegetation qualitative control in corn agrophytocenoses is relevant. Corn has a weak biological potential of coenotic weed resistance in the first half of the growing season. The task of the agronomic service is to protect it from the harmful effects of segetal vegetation and support young crops in the future.

Research results and their discussion. Modern technologies being used in the competitive agricultural crop production are the means of functioning of sustainable systems in agriculture. It is possible to improve the efficiency and stability of agriculture only due to the introduction of intensive crop growing technologies. The latest technologies contribute to a more efficient use of the potential of modern varieties and hybrids, and increase yields and their quality by influencing the productive process of plant development (Bogomaz et al., 2025). Consider that these technologies favour the optimization of production costs with regard to the ecological safety of the environment and maintain the relative agroecosystem balance.

Plants interact with each other through chemical secretions, which have a complex structure and variable composition.

The study of the effects of aqueous extracts of couch grass rhizomes on the germination of corn seeds was carried out in laboratory conditions, which included the assessment of such indicators as germination energy and germination. Weeds that invade crops contest for environmental resources alongside releasing certain chemicals into the soil, thereby lowering yield potential (Lalbiakdika et al., 2021).

Maize is one of the dominant crops in Ukraine and the world (Palamarchuk et al., 2021). Maize is one of the most productive cereals and uses many resources, including soil, moisture, light, nutrients, etc., to generate its productivity (Palamarchuk et al., 2024).

Corn (species *Zea maus* L.) is a crop of versatile use and high yield. Attention to the production of corn grain, as one of the main crops of modern world agriculture, due to the wide range of its use, as it is an important component of agricultural production in Ukraine. There is a tendency in the world to increase the production of corn grain. There can be observed a significant increase in the area under corn grown for grain in Ukraine and World Research of this issue is a relevant and decisive factor in the process of forming the most productive parameters of corn and has scientific and practical significance.

Competitive relations between crops and weeds begin when seeds germinate Studies of the conditions of seed germination in crops have shown an inhibitory or stimulating effect of allelochemicals from weeds.

Competition between crops and weeds is high in the first half of the growing season. The intensity of corn weeding processes depends on many factors, namely the presence of weed seeds and vegetative organs in the soil, the temperature and humidity of the soil, the structure of the soil and its illumination or shading. The search for weed control options will allow herbological protection to be carried out during a critical period for crops and will allow crops to have a high level of potential yield (Khamare et al., 2022; Chenyin et al., 2023).

Scientists also pay attention to the size of corn seeds because the reserves of nutrients from the seed are used during the germination period. Therefore, the external influence is minimized at this time. Its embryo consumes reserve substances from the grain during seed germination. This process requires organic substances to be converted into soluble forms. This transformation occurs due to the work of enzymes activated by phytohormones of the gibberellin group. Moisture absorption processes are based on physical and chemical mechanisms of water sorption from the substrate, but they are necessarily accompanied by biochemical changes. As soon as the synthesis of hormones begins, the seeds begin to germinate. At this time, it intensively uses moisture and spends a lot of energy. The start of competitive relations within a species (in conditions of thickening) and interspecies relations (in conditions of simultaneous germination with other species) will depend on the germination conditions provided by humans to crops.

If crop seedlings are in an environment saturated with allelopathically active substances, their growth rate can change significantly (Chen et al., 2017; Novak et al., 2021; Tsytsiura & Narwal, 2025). Accordingly, crop seedlings may appear on the soil surface sooner or later. Sharp competition between plants in the horizontal plane takes place at the beginning of the growing season. According to Schandry & Becker (2020) therefore, fast and friendly crops have better chances of dominance and formation of a favorable phytoenvironment for themselves. Ecological and microclimatic conditions of the cenosis will be comfortable for the growth and development of crops, so they will be able to control the level of the presence of weedy vegetation and minimize their harmful effects. Thus, the study of the conditions of crop seed germination and the allelopathic influence of harmful weed species on this process is important for modern agricultural science. It should be taken into account that crops also release certain substances into the environment during their growing season. Plants in the phytocenosis adapt to survive and change the living conditions for other species (Kong et al., 2024). They fight for existence through chemical and physical effects on neighboring objects. Each species tries to occupy its ecological niche.

(Gao et al., 2020) have established that phytocompetition in the coenosis depends on the allelopathic activity of the species participating in it. It is difficult to account for the allelopathic pressure of each weed species on the crop under field conditions. As a rule, the influence of one species on cultivated plants is studied under controlled conditions in the laboratory. Allelopathy is a complex ecological phenomenon that has a multi-faceted effect.

Many crop plants and perennial weed species have been known for their allelopathic effects. Roots are the main point of release of allelochemicals. Although allelochemicals are produced by the entire plant, root exudation is the primary source of release of these chemicals into the soil environment.

Coach grass reserves a significant part of the nutrients in underground stems. It emits various substances into the environment that have a significant negative impact on neighboring plants.

The period of seed germination is characterized by intense reactions in seeds. These reactions may vary in rates depending on quality of the aqueous solution and its chemical composition. As a result, the growth processes and the formation of seedling organs are affected (Chenyin et al., 2023).

Weed residues in the soil provide a gradual supply of physiologically active substances to the crop bed. A specific allopathic level is established on each field, which will depend on the vital products of all living components of the agroecosystem.

According to other researchers' studies on the effects of water extracts from different parts of *Elymus repens* L., the highest allelopathic activity is characteristic of its rhizomes (Gao et al., 2020; Tsytsiura & Sampietro, 2024).

These underground parts have been in the soil for many years and can cause significant problems in the cultivation of agricultural crops even after losing their vital activity. They will accumulate various compounds in the presence of moisture in the soil where the rhizomes are located. It is worth knowing their influence on soil microbiota and the root system of crops.

When a germinal root appears, it will absorb both water and substances soluble in it. Their chemical composition will determine the growth rate of this new plant. The chemical composition of aqueous extracts from the rhizomes of *Elymus repens* L. had a significant effect on the germ root growth rate. The length measurement was carried out on the 4th day of the experiment (table 1).

According to Table 1 data, the increase in the extract concentration from the coach grass rhizomes caused a decrease of corn germ root. Note that a higher concentration of allelopathically active substances has a greater effect on seed germination. Weeds are a serious threat to crop production as they interfere with the crop growth and development and result in significant crop losses. Knowledge on allelopathic interactions could be used in sustainable weed management. The lag of germinal roots growth was clearly visible in the Petri dish on the version with 1:100 and 1:10 concentration of the extract from the coach grass rhizomes (fig. 1).

Fig. 1. Energy of corn seed germination on the 4th day

(Fozia et al., 2020) believe that this is the result of inhibition of the germination energy and growth processes.

The analysis of the obtained data showed inhibition of seed germination. If all the seeds began to germinate in the control variant, some of the seeds were in the swelling phase in the experimental variants. In the second variant, a 1:1 000 aqueous extract from coach grass rhizomes was the medium for the corn seeds germination. As a result, only 95,9% of the seeds formed a primary root. Increasing the concentration in the ratio of 1:100 led to the germination of 81,8% of corn seeds; 1:50 led to the germination of 80,4% of corn seeds; 1:20 led to the germination of 79,7% of corn seeds. Only 72,4% of experimental seeds germinated under conditions of the highest concentration of aqueous extract from coach grass rhizomes (1:10). That is, the germination energy of corn seeds depended on the allelopathic action of substances extracted into an aqueous solution from coach grass rhizomes. It decreased with increasing extract concentration. In the sixth variant, the delay in the growth of the corn germ root was 80,8% compared to the control variant. The specimens in the experimental Petri dish differed significantly in size. This means that the grain will germinate unevenly in the field. Taller plants will suppress lower ones that suffer from the neg-

Table 1

The corn germ root length depending on the environment on the 4th day (x ± SD, n = 4)

Variant	Control (distilled water)	Aqueous extract 1:1 000	Aqueous extract 1:100	Aqueous extract 1:50	Aqueous extract 1:20	Aqueous extract 1:10
Germ root, cm	4,78 ± 0,03	4,81 ± 0,03*	2,40 ± 0,02	1,33 ± 0,02**	1,02 ± 0,01**	0,92 ± 0,01**

* – $p < 0,05$; ** – $p < 0,001$ compared to control.

ative effects of weeds. That is, there will be an inhibitory effect of intraspecific competition for such plants. Such an indicator as the density of plant standing will be low in such crops.

The calculations carried out on the 7th day of the experiment also confirmed the inhibitory effect of higher concentrations of aqueous extract from *Elymus repens* L. rhizomes on the seedling height and the root system length of corn.

According to the data in table 2, higher concentrations of aqueous extracts from *Elymus repens* L. rhizomes inhibit the growth of the root system, which should provide the plant with nutrients from the external environment for this particular period of development. Accordingly, such weakened samples of crops will not be able to provide a high level of productivity, worthy of competing with weeds, and good immunity to diseases. The data on the germination of corn seeds in the second variant with the lowest concentration of water extract from wheat rhizomes (1:1 000) are of interest. This is consistent with literature data indicating that the allelopathic effect of knees depends on the concentration level along with other factors (Novak et al., 2021; Schandry & Becker, 2020). It also explains the contradiction in the information about the applied phytoncidal effect between plants (Gao et al., 2020).

All three experimental indicators were higher than in the control variant. Thus, this concentration showed a stimulating effect on the further growth of both the root system and the stem.

This outcome is in line with the researches indicating that the allelopathic effect depends on the level of concentration along with other factors. According to (Gao et al., 2020) it also explains the presence of contradictions in the information concerning the phytoncide effect between plants. The lowest indicators of seedling height and root system length were observed with a 1:10 extract concentration in the sixth variant. The length of the stem was shorter by 30,9%, the length of the germ root was shorter by 63,1%, and the total length of the root system was shorter by 68,5% compared to the control.

Changes in the chemical composition of plants during the growing season should also be taken into account. We mean the presence or absence of certain substances, their percentage ratio, the activity of metabolic processes and the characteristics of the environment into which physiologically active substances are released. Therefore, weed allelochemicals can be successfully used to control pests and other types of weeds in integrated crop production.

Allelochemicals of *Elymus repens* L. inhibited the growth of the corn root system and stalks throughout the experiment. This is how the reaction of the seedlings to the phytotoxicity of the environment took place. Since the germ root grew very slowly in the variants with aqueous extract of coach grass rhizomes in concentrations of 1:20 and 1:10, additional roots began to form on the stem. The growth of the stem on these variants was significantly ahead of the growth of the root system. In other variants, the formation of additional roots in corn seedlings was not recorded. This is how the reaction of the seedlings to the phytotoxicity of the environment took place.

Delay in the growth of plants exposed to the extracted substances of *Elymus repens* L. will affect the height of plants and the formation of grain yield. Consequently, corn plants will lag behind in growth and development at the beginning of their growing season in weedy areas in the field.

The allelopathic pressure created by the exudation of wheatgrass rhizomes has a negative effect on the formation of the root system of corn (fig. 2).

The phytotoxicity of *Elymus repens* L. increases with increasing concentration of the extract. The worst dynamics are in the fifth variant (1:20 concentration) and the sixth one (1:10 concentration). If such an environment is formed around the corn seed in the field, then it can lead to a weak competitive ability of the crop and its low productivity in the future. Therefore, good starting conditions for corn seedlings are a guarantee of a high grain yield in the future. Allelopathy refers to the direct or indirect effect of plants upon neighboring plants or

Table 2

The corn stem height and the root system length depending on the environment of seed germination on the 7th day of the experiment, cm (x ± SD, n = 4)

Variant	Control (distilled water)	Aqueous extract 1:1000	Aqueous extract 1:100	Aqueous extract 1:50	Aqueous extract 1:20	Aqueous extract 1:10
Stem	8,21 ± 0,16	8,28 ± 0,16*	5,97 ± 0,14	5,81 ± 0,15	5,77 ± 0,14**	5,67 ± 0,12**
Germ root	8,42 ± 0,18	8,53 ± 0,18*	6,69 ± 0,16	6,46 ± 0,16	2,31 ± 0,15**	2,11 ± 0,13**
The sum of the root system length	16,84 ± 0,26	16,99 ± 0,28	9,98 ± 0,22	9,46 ± 0,21	6,31 ± 0,20**	5,30 ± 0,21**

* – $p < 0,05$; ** – $p < 0,001$ compared to control.

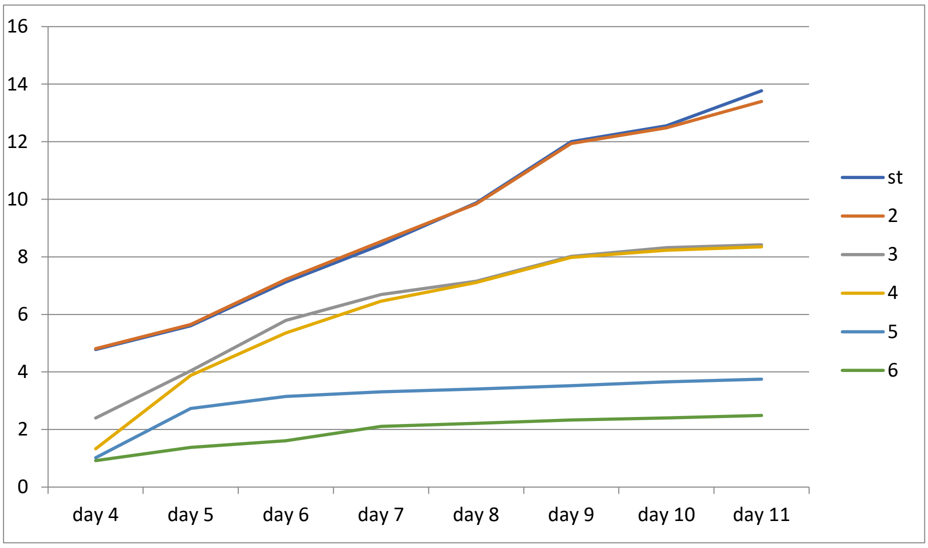

Fig. 2. Growth dynamics of the corn germ root depending on the environment

their associated microflora or microfauna by the production of allelochemicals that interfere with the growth of the plant.

Every plant produces certain substances over the course of its life. Thus, it affects neighboring species, i.e., it forms an environment according to its needs. When an allelochemical is released into the environment, it undergoes a number of interacting processes. Allelochemicals can either directly affect the target (direct allelopathy) or, when released into the soil, degrade to secondary degradation products, which can either harm plant development or modify the microenvironment, indirectly affecting the growth. The allelochemicals are released from plant parts by leaching from leaves or litter on the ground, root exudation, volatilization from leaves, residue decomposition, and other processes in the natural and agricultural systems. Upon release, the allelochemicals can suppress the germination, growth, and establishment of the surrounding plants or modify the soil properties in the rhizosphere by influencing the microbial community.

An important role in the nutrition of corn is played by the embryonic and 3–5 primary lateral roots in the first 7–11 days. Then there will be the formation of additional roots, which will perform the main role in the nutrition of plants in the future, and a fibrous root system will be formed. The growth and development of the aerial part of the corn will depend on the rates of formation of the germinal and primary lateral roots.

Improved technologies for growing crops, which provide for the maximum use of biological factors, the formation of a stable structure of trophic relationships in microbial cenoses, that increase their resilience to life factors and their integration into the soil is a controversial issue for modern agricultural science and practice. Early adaptative nature, rapid growth, and fast spread of weeds make them able to inhibit growth of desired crops and reduce the final estimated yields.

The graph shows a significant lag in the growth of corn stalks on experimental variants except where the concentration of the extract is 1:1 000. This minimal amount of secondary metabolites has a stimulating effect on the germination processes of corn seeds. At higher concentrations, these same substances inhibit growth processes in corn (fig. 3).

The study of phytocenotic interactions between plants is of particular relevance. Release and fate of allelochemical are influenced by plant, soil and environmental factors. Plant groups are characterized by a specific microclimate that must be taken into account by farmers. A significant part of the issues (cultivation technology, poisoning, fertilization, chemical protection, etc.) have been solved by scientists. However, focusing on other issues will avoid creating problems in the form of undesirable consequences that require human intervention to maintain crops.

Plant-plant interactions are a central driver for plant coexistence and community assembly. Mechanism of plant specific allelopathic interactions needs more investigation. The studies on transport processes involving the release of allelochemicals from plants need more attention so as to exploit this knowledge in regulating the output of these compounds at a cellular level.

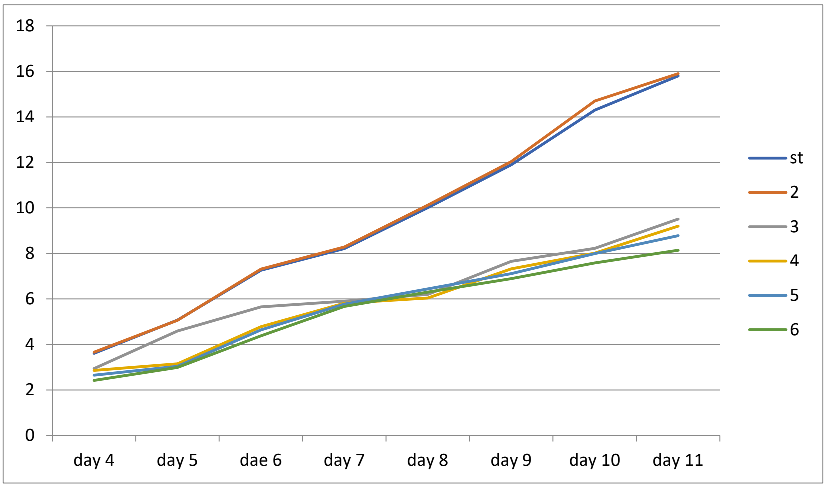

Fig. 3. The dynamics of corn stem growth depending on the environment

Conclusions. The substances contained in the aqueous extract from wheatgrass rhizomes inhibited the germination energy of corn seeds. According to the concentration of the solution, this indicator decreased by 18,2% (1:100), by 19,6% (1:50); by 20,3% (1:20) and 27,6% (1:10). The variant with a 1:1 000 concentration aqueous extract from Elymus repens L. rhizomes had a stimulating effect on the initial growth of both the root system and the coleoptile of corn. Aqueous extracts of Elymus repens L. rhizomes in a concentration of 1:100; 1:50; 1:20 and 1:10 have a negative effect on the germination of corn seeds. They inhibit the growth of the germinal root from 20,5% (1:100) to 74,9% (1:10), and subsequently, the stem from 27,3 to 30,9%.

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Verheles P.N. – design of the work, article corrections, critical review;

Yakovets L.A. – data collection and analysis, participation in writing the article.

Corresponding author's email: ***svitlanaokruzko@gmail.com***