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# ALLELOPATHIC EFFECT OF *AILANTHUS ALTISSIMA* EXTRACT ON THE GERMINATION OF *ZEA MAYS, OCIMUM BASILICUM* AND *PHACELIA TANACETIFOLIA* SEEDS

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***Key words:*** *Ailanthus altissima, ethanolic extract, allelopathic effect, seeds germination*

## INTRODUCTION

*Ailanthus altissima* (Mill.) Swingle (tree of heaven, ailanthus) from Simaroubaceae DC. native to East Asia (China, Taiwan) is now distributed almost everywhere, as it has been cultivated for many decades as an ornamental and landscaping plant (Bostan et al., 2014; Kucher, 2015;Sladonja, 2015; Rebbecketal., 2017; Weber, 2017; CABI, 2022, EPPO Global Database, 2022). This perennial deciduous tree or shrub belongs to dioecious plants. However, in nature there are bisexual plants and even polyoecious plants with bisexual and unisexual flowers (Zasada and Little, 2008; Ferreira et al., 2013; Ivanova and Elisovetcaia, 2018). In many countries of the world, including the vast majority of European countries, it is considered a noxious weed and is included in the list of quarantine objects due to its high growth rate and seed productivity, as well as its aggressive root system (Henderson, 2001; Miller, 2003; Constan-Nava et al., 2010; Boer, 2013; Elgohary et al., 2022).

In the Republic of Moldova, as well as in the Slovak Republic, ailanthus is quite widespread and occurs both as an ornamental plant and as a weed (Ghendov et al., 2012; Ivanova and Elisovetcaia, 2018; Elisovetcaia et al., 2020; Wittlinger, 2022). Some of its bioecological features contribute to the rapid spread of ailanthus. First, *A. altissima* reproduces from both seed and root sprouts. Root shoots can appear at a distance of up to 15 m and the plants have a thicker trunk and a faster growth rate. Secondly, the ailanthus has an extremely high fecundity of females, according to some estimates, up to a million seeds per year, which are easily dispersed by the wind (Dirr, 2009; Daneva et al., 2017; Wickert et al., 2018). Studies of the reproductive ability of ailanthus plants have shown that seed production can exceed local similarly prolific species (for example, *Acer platanoides* L.) by several orders, surpassing other invasive species in terms of viability (for example, *Robinia pseudoacacia* L.), moreover, without periodic seed failure (Sladonja et al., 2015; Wickert et al., 2018). Another significant reason for the successful spread of an alien species in new areas may be the presence of an allelopathic effect due to the content in all parts of the ailanthus, especially in the roots, phenolic compounds that act on the proteins involved in mitosis in plants growing nearby (may be related to phenol compounds interacting with proteins involved in mitosis) (Marinaş et al., 2018). In addition to phenolic compounds, ailanthus contains quassinoids with pesticidal and herbicidal properties (Demasi et al., 2019; Caser et al., 2020). Previously, we studied the insecticidal, ovicidal, antifeedant, deterrent, repellent, and acaricidal properties of alcoholic and aqueous extracts from ailanthus (Elisovetcaia et al., 2013, Elisovetcaia et al., 2020). Among other things, pronounced phytotoxicity concerning cultivated plants was found, due to which the use of ailanthus as a plant insecticide has significant limitations (Elisovetcaia et al., 2020).

Therefore, the purpose of our work was to study the allelopathic effect of ethanolic extract from leaves of *Ailanthus altissima* on the germination of *Zea mays, Ocimum basilicum* and *Phacelia tanacetifolia* seeds.

## MATERIALS AND METHOD

The experiments were carried out in laboratory conditions during 2022, in the Laboratory of Natural Bioreglators, Institute of Genetics, Physiology and Plant Protection (IGPPP), Chisinau, Republic of Moldova, and in the Institute of Plant and Environmental Sciences**,** Slovak University of Agriculture in Nitra, Slovak Republic.

**Plant materials.** Ailanthus leaves were collected in the central zone of the Republic of Moldova during June 2022 both from young growth (first year of growth) and from the lower tier of adult fruit-bearing trees. (Fig. 1a, b, c).

The plant material was dried at room temperature away from sunlight, then crushed using the laboratory mill, powdered to uniform-size of particles passing through a sieve with apertures 1.0 mm in diameter.Moisture and dry matter of plant materials and extracts were determined using

Moisture analyzer MAX series, RADWAG 26 – 600 Radom.

**Extraction.** The dry, crushed and powdered plant raw material (leaves) of *A. altissima* plant was extracted with 96% ethyl alcohol in the ratio plant materials: solvent – 1:5. The mixture was shaken for4 hours on a laboratory shaker, then infused for 72 hours, followed by evaporation of the solvent. The precipitation was diluted with 96% ethanol and the extract containing in 20 g per 100 mL of dry matter was obtained. To test the allelopathic effect on seeds, the extract was diluted with distilled water to a concentration of 2.5 and 1.25% of dry matter, the concentration of ethanol in these dilutions does not exceed 5.0%.

**a** **b**

Figure 1. Young shoots of *Ailanthus altissima* (a) and fruit-bearing plants (b), urban outskirts, Republic of Moldova, 2022

**Biological activity.** The allelopathic effectof ethanolic extract from *A. altissima* was studied using seeds with a higher germination rate of cultivated monocotyledonous plant *Zea mays* L. (Poaceae), and dicotyledonous weeds *Ocimum basilicum* L. (Lamiaceae) and *Phacelia tanacetifolia*Benth. (Hydrophyllaceae). Seeds were treated by immersion for 30 minutes in 0.5% solutions of potassium permanganate. Then the seeds were washed with water and placed between layers of filter paper (two from below, one from above) soaked in 4 ml of tested extracts.

The seeds were germinated in Petri dishes between moistened filter paper disks in a thermostat at the temperature of 25 °C (Rao et al., 2006, ISTA, 2022). Each variant consisted of four replicates, 100 seeds per replicate. Seeds treated with water served as a control 1, seeds treated with 5.0% solution of ethanol served as a control 2, and seeds treated with herbicide Glifostar (dose 10.0 ml/l) served as a standard.

The energy of germination, total germination rate, the length of roots and shoots were determined. The allelopathic effect on seeds of 1.25 and 2.5% solutions of ethanolic extract A. *altissima* were determined according to standard methods in relation to controls and standard. Germination was recorded on 7 days for *Z. mays*, and 14 days for *O. basilicum* and *P. tanacetifolia* seeds (ISTA, 2022).

**Statistical analysis.** Values were presented as the mean of four replicates. For all parameters, mean differences were calculated or compared using a one-way and univariate ANOVA with the Tukey post-hoc test ($p \leq 0.05$). The data analysis was performed with Statgraphics Plus 5.0 software (Nau, 2005).

## RESULTS AND DISCUSSIONS

First of all, it should be noted that control 2 didn't different from control 1, i.e. the residual concentration of alcohol in solutions did not have a suppressive effect on seed germination. As a result of the experiments, it was found that the extract from *A. altissima* at a high concentration of 2.5% dry matter has a negative allelopathic effect on all the seeds we tested (Table 1, Figure 2, 3). The highest rate of germinated seeds was noted in the variant with *Z. mays* (8.5%), and the lowest was in the seeds of *P. tanacetifolia* (1.0%). At the same time, in the variants with treatment with *A. altissima* extract, the tested seed species had no shoots growth at all, and the root length did not exceed 0.50 cm (Table 2, Figure 3).

It was established that the seeds treated with the extract from *A. altissima*, as well as in the standard, had a low germination energy, which was an order of magnitude less than in both control variants. With a twofold decrease in concentration to 1.25%, a significant increase in germinated seeds of *O. basilicum* from 5.00 to 37.75% was noted, which was still significantly (2.5–2.6 times) lower than in the control and standard ($LSD_{0.05}$ = 6.41, $p \leq 0.05$). It should be noted that the seeds of *O. basilicum* were quite resistant to the chemical herbicide standard (Glifostar).

They developed not only roots but also shoots (Figure 2 f). However, in the variant with the herbicide (standard), the complete death of germinated seeds (destructive tissue changes) was subsequently noted. In the seeds of *Z. mays* and *P. tanacetifolia*, despite the higher percentage of germination in the standard compared to the seeds of *O. basilicum*, only the roots germinated, and then very weakly – their length was 7.4–43.3 times less than in the control. In the course of further observations, it was revealed that the seeds of *Z. mays* and *P. tanacetifolia* germinated in the chemical standard, as well as *O. basilicum*, died: after germination, the roots were subjected to destructive processes, turned yellow and softened. It should be noted that the extract from *A. altissima* acted on seeds similarly to the herbicide Glifostar: the length of the roots of germinated seeds, regardless of the tested concentration of the extract, fluctuated within very small limits and was 41.7–43.3 times less than the control for *Z. mays*, in 31.3–31.4 times for *O. basilicum* and 7.4–7.7 times less for *P. tanacetifolia* seeds. Similar data on the inhibitory activity of the ailanthus extract on seed germination of *Raphanus sativus* L. and *Lepidium sativum* L., as well as on the growth of roots and shoots, were obtained by other authors (Caser et al., 2020).

Table 1. Germination of *Zea mays,Ocimum basilicum,*and *Phacelia tanacetifolia* seeds treated with the ethanolic extract from *Ailanthus altissima*

| **Variants** | **Seeds germination, %** | | |
|---|---|---|---|
| | *Zea mays* | *Ocimum basilicum* | *Phacelia tanacetifolia* |
| **Control 1** | 98.00$^{a}$ | 94.75$^{a}$ | 68.75$^{a}$ |
| **Control 2** | 94.00$^{a}$ | 100$^{a}$ | 86.00$^{a}$ |
| **Extract 2.50%** | 8.50$^{b}$ | 5.00$^{b}$ | 1.00$^{b}$ |
| **Extract 1.25%** | 12.50$^{b}$ | 37.75$^{b}$ | 5.25b$^{c}$ |
| **Standard** | 95.00$^{a}$ | 95.00$^{a}$ | 26.75$^{c}$ |
| **$LSD_{0,05}$** | **6.07** | **6.41** | **21.76** |

Note: Mean values showing the same letter are not statistically different at p ≤0.05, according to the Tukey post-hoc test. The statistical relevance of the "Between-Subjects Effects" tests is provided (p <0.05). Lowercase letters (a, b, c) refer to differences in columns

Statistical analysis of the data showed that the difference in germination capacity between control seeds and seeds treated by the ethanolic extract from *A. altissima* for all seeds selected as a test object was significant ($p \leq 0.05$).

At the same time, the length of the roots of germinated seeds in the experiment differ significantly from the control ones and reached only 0.30 cm for *Z. mays* ($LSD_{0.05}$ = 0.51, $p \leq 0.05$) and 0.50 cm for *O. basilicum* and *P. tanacetifolia* ($LSD_{0.05}$ = 4.25 and 1.03, respectively, $p \leq 0.05$) (Table 1, 2).

Table 2.Germination characteristics of *Zea mays,Ocimum basilicum,*and *Phacelia tanacetifolia* seeds treated with the ethanolic extract from *Ailanthus altissima*

| **Variants** | ***Zea mays*** | | ***Ocimum basilicum*** | | ***Phacelia tanacetifolia*** | |
|---|---|---|---|---|---|---|
| | **S$^{*}$** | **R$^{**}$** | **S$^{*}$** | **R$^{**}$** | **S$^{*}$** | **R$^{**}$** |
| **Control 1** | 1.45$^{a}$ | 12.98$^{a}$ | 14.70$^{a}$ | 15.70$^{a}$ | 3.14$^{a}$ | 3.86$^{a}$ |
| **Control 2** | 1.40$^{a}$ | 12.50$^{a}$ | 14.52$^{a}$ | 15.64$^{a}$ | 3.16$^{a}$ | 3.72$^{a}$ |
| **Extract 2.50%** | - | 0.30$^{b}$ | - | 0.50$^{a}$ | - | 0.50$^{b}$ |
| **Extract 1.25%** | - | 0.30$^{b}$ | - | 0.50$^{b}$ | - | 0.50$^{b}$ |
| **Standard** | - | 0.30$^{b}$ | 0.30$^{b}$ | 0.50$^{b}$ | - | 0.50$^{b}$ |
| **$LSD_{0,05}$** | **0.49** | **0.51** | **2.15** | **4.25** | **1.12** | **1.03** |

Note: *S – Shootslength, cm; **R – Roots length, cm.
Mean values showing the same letter are not statistically different at p ≤0.05, according to the Tukey post-hoc test. The statistical relevance of the "Between-Subjects Effects" tests is provided (p <0.05). Lowercase letters (a, b, c) refer to differences in columns

Thus, the alcohol extract from *A. altissima* exhibits an allelopathic effect on both cultivated plant seeds and weed seeds like a chemical herbicide, inhibiting root growth and, in most of the variants we tested, completely suppressing the growth of shoots.

Our data on the negative effect of ailanthus extract on cultivated *Z. mais* correlate with studies by Heisey and Kish Heisey, who found that treatment with a methanol extract from ailanthus leaves not only provides partial (40%) weed control in cultivated crops, but also causes serious damage to the crops of the latter, including sweet corn (Heisey and Kish Heisey, 2003).

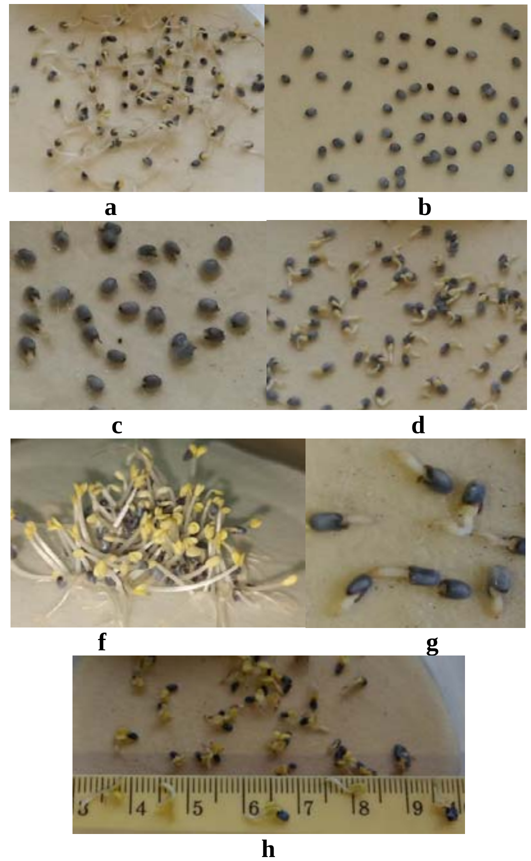


Figure 2. Germination of *Ocimum basilicum* seeds: on the 4th day of counting, the rate of germinated seeds characterizes the energy of germination– control 1 (a), 2.5% and 1.25% ethanolic extracts *Ailanthus altissima* (b & c), standard Glifostar (d); on the 10th day of counting, the rate of germinated seeds characterizes the germination capacity – control 1 (f), 1.25% ethanolic extracts *Ailanthus altissima* (g), standard Glifostar (h)

Similar data on the inhibitory activity of the ailanthus extract on the germination of *Medicago sativa* seeds were obtained by a group of Croatian scientists (Sladonja et al., 2014). At the same time, Caser et al. (2020) found that ailanthone at a concentration of 1.8 to 50 mg $L^{-1}$ significantly inhibited the germination of seeds of *Raphanus sativus* L. and *Lepidium sativum* L. compared to water control. The authors calculated the Index of germination (IGe, %), which takes into account not only the number of germinated seeds but also the ratio of the average length of the roots in the experiment compared to the control. As a result, the lowest IGe of 2.9% was obtained for both species of seeds for the extract from the secondary roots of ailanthus, and the highest IGe of 24.4% was obtained for the extract from the leaves of the plant. At the same time, for the seeds of *R. sativus* and *L. sativum*, the germination index for the leaf extract at a dose of ailanthone 1.8 mg $L^{-1}$ was significantly higher and reached 112.55 and 165.99%, respectively (Caser et al., 2020).

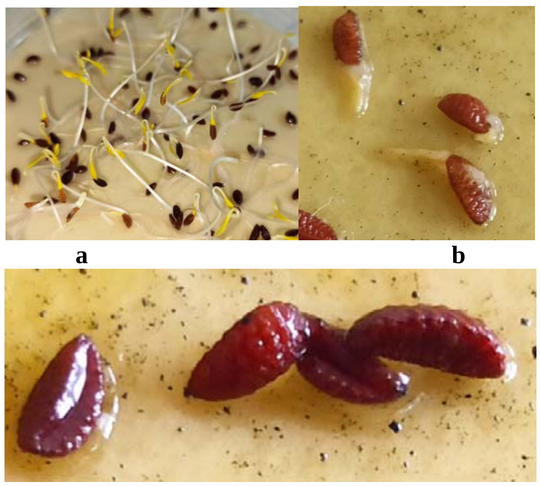


Figure 3. Germination of *Phacelia tanacetifolia* seeds: – control 1 (a), 1.25% ethanolic extracts *Ailanthus altissima* (c), standard Glifostar (b)

Novak et al. (2021) analysed allelopathic effect of 3 different aqueous solutions (root aqueous solution, aqueous solution with isolated ailanthone and root aqueous solution without ailanthone) from root extract of tree of heaven's (*Ailanthus altissima*). Concentrated root and ailanthone aqueous solution and dilutions were equivalent to concentration of 0.48 mg/mL ailanthone. Each of these solutions was diluted with water in ratio 1:4 and 1:16 before application on seeds of 3 test-plant species – *Triticum aestivum* L., *Amaranthus retroflexus* L. and *Setaria pumila* L. It was found the high allelopathic effect on radicle and shoot length of all test-species for all investigated aqueous solution and their dilutions from tree of heaven's root extract (Novak et al., 2021). These data correlate well with our findings on the inhibitory effect on the germination of shoots, as well as on the growth of rootlets of the tested plants.

Pedersinia et al. (2011) evaluated the fractions obtained by extraction of ailanthus bark. A direct correlation was found between the content of ailanthone in the extract and pre-emergence herbicidal activity against *Amaranthus*, *Chenopodium,* and *Festuca*. It was shown that fractions containing from 1 to 5 mg/l of ailanthone more effectively suppressed root growth than epicotyl. The greatest effect in suppressing the germination of epicotyls was achieved with *Festuca* seeds. Thus, extracts from ailanthus act selectively on the seeds of different plant species – in some, they inhibit both the growth of roots and shoots, in others, they have a greater effect on shoots, in still others, they act on roots (Pedersinia et al., 2011). And other authors also associate the inhibitory effect on seed germination with an increase in the concentration of ailanthone (Heisey, 1996; Pisula and Meiners, 2010; Novak, 2017; Novak et al., 2018). It is difficult to make a correlation between our experiments since we did not determine the content of ailanthone in the extract. However, our data are still in good agreement with the opinion of the authors that ailanthone is not the only substance in ailanthus that has allelopathic efficacy (Heisey, 1999; De Fao et al., 2003; Caramelo et al., 2021). Also, a decrease in the germination in our experiments of seeds of *Z. mays*, *O. basilicum* and *P. tanacetifolia* with an increase in the concentration of the extract correlates with an increase in the content of ailanthone and other active components. The data obtained by Nowak (2017) showed that despite the significant effect of ailanthone on the seed germination rates of test objects, exceptions were found when the effect was equally strong at all dilutions (Novak, 2017). This may testify in favor of the fact that in the extract of *A. altissima* in addition to ailanthone, other compounds also have an allelopathic effect, as a result, a synergistic effect is observed.

Demasi et al. (2019) also believe that the high phytotoxic properties of ailanthus extracts are due to the content of quassinoids in it, among which ailanthone (Ail) plays the most significant role (Demasi et al., 2019). It was previously thought that ailanthon's high extraction and purification costs, as well as its low persistence in soil, might limit for its development as herbicide for open field applications (Anfossi et al., 2020). However, Demasi et al. (2019) found that Ail inhibited the growth of two test plant species *Lepidium sativum* L. and *Raphanus sativus* L. by 80-90% already at low doses (7.5 mg l-1) in both tested methods - on filter paper and in soil, while more high concentrations (≥ 30 mg l-1) were required in the culture substrate to obtain similar results (Demasi et al., 2019).

Despite the higher content of ailanthone in the bark and roots of *A. altissima*, its production from the leaves for agricultural purposes makes more sense due to the simplicity and cheapness of the method. The results of our experiments have shown that there is no crucial need to obtain pure ailanthone, since obtaining a total extract is less energy- and resource-consuming, and in terms of efficiency, such an extract is not inferior to individual fractions.

The quassinoid ailanthone has not only pronounced herbicidal properties, but also nematodocidal properties. Lehmann et al. established, that the *A. altissima* extract (1 mg/mL) irreversibly inhibited the reproduction of *Caenorhabditis elegans* (Caenorhabditis) L4 larvae. This effect was dependent on the larval stage since L3 larvae and adults were less affected. Bioactivityguided fractionation revealed the quassinoid ailanthone 1 as the major active compound (IC50 2.47 μM). The extract caused severe damages to germ cells and rachis, which led to none or only poorly developed oocytes (Lehmann et al., 2020).

Tan et al. (2020) isolated two new quassinoid glycosides, named chuglycosides J and K. The new structures were active against tobacco mosaic virus. They had an inhibitory effect on virus multiplication with half maximal inhibitory concentration ($IC_{50}$) values of 56.21 ± 1.86 and 137.74 ± 3.57 μM, respectively (Tan et al., 2020). Morre et al. considered that the bioactivity of quassinoids is based on the plasma membrane NADH oxidase inhibition (Morre et al., 1998).

The crude *A. altissima* leaf extract showed significant inhibition of *Medicago sativa* seed germination in both light and dark conditions. However, the methylene chloride fraction showed the maximum inhibitory effect – its $IC_{50}$ (concentration that inhibits alfalfa root growth by 50%) was approximately 2–3 times higher in the presence of light (4.7 ppm) compared with incubation in the dark (12, 8ppm) (Tsao et al., 2002). However, in this study, the primary extraction was carried out with methanol, which was evaporated to dryness. The dry residue was dissolved in water and divided into two parts. The first part –- fraction A. From the second part, the active components were extracted with acetone (fraction B) and methylene chloride (fraction C) (Tsao et al., 2002).

Ailanthus extracts have a wide spectrum of action due to their rich chemical composition. Liet al. (2021) isolated and characterized about 221 chemical compounds from ailanthus, including alkaloids, quassinoids, phenylpropanoids, triterpenoids, essential oils, and other compounds; among them, the most typical is the quassinoid ailanthone (Liet al., 2021). The crude extracts and active compounds of *A. Altissima* exert a wide range of pharmacological activities, such as antitumor, anti-inflammatory, antiviral, herbicidal, and insecticidal activities.

The allelopathic properties of *A. altissima* have been known for a long time (Heisey 1990; Zhang et al., 2021). Heisey (1990) found that, first, compounds with inhibitory activity were most fully extracted from various parts of the ailanthus plant with methanol, but not with dichloromethane, indicating polar characteristics (Heisey 1990). For this reason, we also opted on a polar solvent - ethyl alcohol. Secondly, crude extracts of ailanthus root bark and leaflets corresponding to 34 and 119 mg water extractable material/L, respectively, caused 50% inhibition of cress radicle growth (Heisey 1990).

Zhang et al. (2021) believe that the reported strong negative effects of some long-lived tree species in nature may be due to the accumulation of large amounts of allelochemicals over time, while short-lived weed species reserved fewer allelochemicals due to their short generation time and high spatial turnover. On the other hand, crop vulnerability may result from growing crops in monoculture, resulting in low allelochemical diversity and therefore lower resistance to weed infestation (Zhang et al., 2021). Under the influence of phytophage pests, pathogenic agents, as well as plants competing for resources, secondary metabolites are selected, due to which plants that have evolved in different regions may not adapt to each other (Uesugi and Kessler, 2013; Zheng et al., 2015). Thus, invasive plant species, which include the studied *Ailanthus altissima*, can serve as a source of biologically active substances with herbicidal and allelopathic properties.

The presence of allelopathic properties in invasive plant species is also confirmed by the studies of Kato-Noguchi and Kurniadie (2022), who found that the extracts, leachates, root exudates, litter, decomposing residues, and rhizosphere soil of *Leucaena leucocephala* (Lam.) de Wit increased the mortality and suppressed the germination and growth of several plant species, including weeds and woody plants (Kato-Noguchi & Kurniadie, 2022). *L. leucocephala* is native to southern Mexico and Central America and is now naturalized in more than 130 countries. Several putative allelochemicals such as phenolic acids, flavonoids, and mimosine were identified in *L. leucocephala*. The species produces a large amount of mimosine and accumulates it in almost all parts of the plants, including leaves, stems, seeds, flowers, roots, and root nodules. The concentrations of mimosine in these parts were 0.11 to 6.4% of their dry weight. Mimosine showed growth inhibitory activity against several plant species, including some woody plants and invasive plants (Kato-Noguchi & Kurniadie, 2022).

Corrêa et al. (2008) found that aqueous extracts of dried powdered leaves of the Brazilian shrub *Psychotria leiocarpa* at a concentration of 4% (w/v), containing N-glycosylated indole alkaloid N,β-d-glucopyranosylvincosamide (up to 2.5% by dry weight), inhibited the germination and/or early growth of three different test species – *Lactuca sativa* L., *Mimosa bimucronata* (DC.) Kuntze and *Chorisia speciosa* A. St.-Hil. (Corrêa et al., 2008).

## CONCLUSIONS

It has been established that the ethanolic extract from *Ailanthus altissima* has a negative allelopathic effect not only on the seeds of two dicotyledonous weed species *O. basilicum* and *P. tanacetifolia*, but also on the seeds of the cultivated monocot plant *Z. mays*. At a concentration *of A. altissima* extract of 1.25 and 2.5% (by dry matter), seed germination of *P. tanacetifolia* and *O. basilicum* is reduced by 94.75-99.0% and 62.25-95.0%, respectively. At the same time, the germination of *Z. mays* seeds decreases depending on the concentration of *A. altissima* extract by 87.5-91.5%. However, the chemical standard Glifostar significantly (by 93.25%) suppressed the germination of only *P. tanacetifolia* seeds. Ailanthus extract at both tested concentrations of 1.25 and 2.5% completely suppressed the germination of seeds shoots in all three tested species, and the root length of germinated seeds was significantly less comparison to both controls (water and 5.0% ethanol). Thus, despite the presence of a negative allelopathic effect of the *A. altissima* extract in relation to some species of weeds, it should be used with caution in practice – studies of the effect of the extract on seed germination and the growth of roots and shoots of cultivated plants in agrocoenosis are needed.


## ABSTRACT

Extracts from various parts of the plant *Ailanthus altissima* (Mill.) Swingle, due to the content of phenolic compounds and quassinoids, may have herbicidal or allelopathic properties against various plant species. The most valuable are natural herbicides with selective action. Therefore, the purpose of our work was to study the allelopathic effect of the ethanol extract from leaves of *A. altissima* on the germination of seeds of both cultivated (*Zea mays* L.) and weed (*Ocimum basilicum* L. and *Phacelia tanacetifolia* Benth.) plants.

It was found that under laboratory conditions, the extract of *A. altissima* at a concentration of 1.25–2.50% significantly ($p \leq 0.05$) suppressed the germination of all tested seeds, and also completely suppressed the growth of the shoots. The length of the roots in the variants with the extract was significantly lower than the control (41.7–43.3 times for *Z. mays*, 31.3–31.4 times for *O. basilicum* and 7.4–7.7 times for *P. tanacetifolia*) and at the level of a chemical standard (0.30–0.50 cm). The most significant allelopathic effect was found in the extract of *A. altissima* at a concentration of 2.5% dry matter – the suppression of germination was 91.5-99.0%, depending on the species of seed: the highest rate of germinated seeds (8.5%) was noted for the cultivated plant *Z. mays*, while the lowest (1.0%) is found for the seeds of *P. tanacetifolia*. It was established that the seeds treated with the extract from *A. altissima*, as well as in the standard, had low germination energy, which was an order of magnitude less than in both control and chemical standard variants. The least sensitive to the effects of the *A. altissima* extract at a concentration of 1.25% were the seeds of *O. basilicum* – germination was 37.75%, which was still significantly (2.5–2.6 times) lower than in the control and standard. Therefore, *A. altissima* ethanolic extract did not show selectivity of action and showed allelopathic properties both in relation to the dicotyledonous weeds of *O. basilicum* and *P. tanacetifolia*, and in relation to the cultivated monocotyledonous *Z. mays* plant.



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