# INFLUENCE OF *AMBROSIA ARTEMISIIFOLIA* EXTRACT ON GERMINATION AND GROWTH OF *AMARANTHUS RETROFLEXUS* AND *ZEA MAYS*

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***Abstract.*** *Common ragweed is a species with a negative impact on: agriculture, biodiversity and human health. This plant produces a large amount of strong allergen pollen, producing allergic rhinitis and severe asthma, affecting more than 20% of the population of infested areas. In recent years, Ambrosia artemisiifolia in Romania shows the trend of invasion of agricultural crops, where it can cause high damages by decreasing the quantity and quality of yield and harvesting efficiency. Ambrosia artemisiifolia threatens the biodiversity of ecosystems by releasing into the environment some compounds of the allelopathic nature, thus eliminating other species. The research carried out by Beres revealed that this species contains phenolic and terpene compounds. The allelopathic influences of A. artemisiifolia were tested in soybean, rice and maize bioassays. The purpose of this study was to highlight the allelophatic effect of the species Ambrosia artemisiifolia on crop plants (maize) and on spontaneous plants (redroot pigweed). Research was conducted under laboratory conditions. The experience included 3 variants in 3 replicates, both for maize and for redroot pigweed. 25 g of material mixed with 800 ml of distilled water was used to prepare the extracts, they were placed on the magnetic stirrer for six hours, after which filtration was carried out. The maize and redroot pigweed seeds were placed on a filter paper in a Petri dish (10 seeds / Petri dish). The extracts used in the study differed by the three concentrations: 30%; 60% and 90%. The maize seeds were treated with 6 ml of the respective extract, 12 ml for redroot pigweed seeds. It was observed that maize seeds showed germination rates ranging from 90% to 100%. The extracts from the leaves of Ambrosia artemisiifolia in the concentration of 60% and 90% reduced germination of maize seeds by 10% compared to the control. The corn root length was between 2.39 cm - 5.06 cm. The height of the maize plants, at 7 days after treatment, presented values of 1.17-3.30 cm. The studies carried out showed that the variants treated with leaf extract of Ambrosia artemisiifolia 30% determined the stimulation of the root length and the "height of the plant" character. The extracts of the leaves of the common ragweed have caused very significant decrease of Amaranthus retroflexus seeds germination (2.22% - 80%).*

***Keywords****: Ambrosia artemisiifolia, Amaranthus retroflexus, extract, concentration, allelopathic*

## INTRODUCTION

Common ragweed is native to North America and it seems that in Europe has been brought with different cereals. First reported in European botanical gardens in the last half of the 1800s, spreading to several European countries in the early 1900s (CHAUVEL et al., 2006; VOGL et al., 2008). In Germany the first report date from 1863. In Romania it was first obseved in Orsova in 1910 (JÁVORKA 1910, cited by ARSENE A. and all., 2006). And if it was mentioned only 40 years ago on the Danube and the Somes floodplains (NYÁRÁDY 1964, cited by ŞTEF R., 2017), it is now present all over the country, from the plain up to 600 m altitude.

This species is often present as a weed in field crops, such as maize, sunflower, soybean and wheat (BASSETT and CROMPTON, 1975; FUMANAL et al., 2008), as well as in horticultural crops and quite common on abandoned land ( RAYNAL and BAZZAZ, 1975) and other habitats. It is also a weed present along roadsides and in some urban areas (LAVOIE et al., 2007).

At this very moment, studies related to *Ambrosia artemisiifolia* focus on extremely allergic pollen (WAYNE et al., 2002). The high allergic potential coupled with its wide distribution has led health organizations to include the ragweed species in the list of the most

problematic invasive plants in Europe (WAYNE et al., 2002). Currently, 20% of the population of areas infected with *Ambrosia artemisiifolia* suffer from allergic rhinitis and severe asthma.

The ragweed is an invasive, non-indigenous species (not native to that location) that has been very aggressive, leading to the deterioration of biodiversity, human health and economic structure (MACK et al. 2000, VIJAYA Y. et. al 2016). The studies conducted by INDERJIT et al. 2008 and RASTOGI et al. 2015 showed that invasive species are the major cause of biodiversity loss. Invasive species are responsible for 40% of the list of endangered species (WILCOVE et al., 1998).

The studies carried out by RABITSCH and ESSL (2006) tried to explain the invasion phenomenon of the species *Ambrosia artemisiifolia* by the fact that the abiotic factors did not represent a barrier in the extension of the species, there were no natural enemies, release allelopathic products, through this the evolution of the plant community is accelerated (WARWICK, 1991).

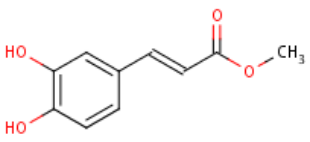
The problem of invasiveness of the invasive species *Ambrosia artemisiifolia* L. is an important issue for Romania and other countries (BONEA D. et al., 2018).

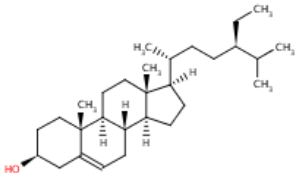
In recent years, in Romania, *Ambrosia artemisiifolia*, shows the tendency to invade agricultural crops, where it can cause special damages (ANGHEL et al. 1972; MANEA D. et al., 2006; ȘTEF R. 2017) by decreasing: quantity and quality of production, efficiency of harvesting.

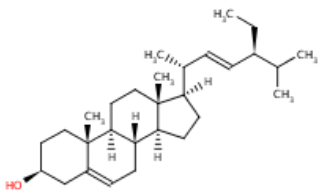
*Ambrosia artemisiifolia* threatens the biodiversity of ecosystems, by releasing some allelopathic compounds into the environment eliminating other species (ȘTEF R., 2017).

Research conducted by BERES et al., 2002, revealed that this species contains phenolic and terpene compounds. These substances affect cell division and enzymatic processes, reduce mitotic activity and interfere with microtubule activity (STURGEON et al., 2005).

Phenolic acids are present in larger quantities in the root system of the species *Ambrosia artemisiifolia*. From the roots of Ambrosia artemisiifolia were obtained four polyacetylene, a mixture of sesquiterpene hydrocarbons, methyl coffee and a mixture of β-sitosterol and stigmasterol (FISCHER N., 1985, MOLINARO F., et al, 2016).





Methyl caffeate Sitosterol Stigmasterol

(https://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:28824)

The allelopathic effects of root exudates from *Ambrosia artemisiifolia* on germination of plant species are described by KAŠPAROVÁ (2015). The root exudates of Ambrosia artemisiifolia inhibited the growth of cereals (*Hordeum vulgare* L. and *Triticum aestivum* L.) and *Lycopersicon esculentum* Mill. and so on (VIDOTTO F. et al., 2013, JINDŘICH et. al. 2016). The results of the research conducted by WANG DALI, ZHU XINRU (1996) are contradictory to those obtained by VIDOTTO F. et al. (2013), they stated that the aqueous extracts from the roots of

*Ambrosia artemisiifolia* have no effect on germination of wheat, corn, rice, soybean seeds, but that they affect the primary growth of crops. Sesquiterpenes are found especially in the upper part of *Ambrosia artemisiifolia* L. (leaves, flowers, fruits). The first report on the isolation of sesquiterpenes from the upper parts of the species *Ambrosia artemisiifolia* dates from 1993 (LU et al., 1993).

Water extract based on upper part of the species *Ambrosia artemisiifolia* determines significant inhibitory effects on seed germination and primary crop growth (soybean, corn, wheat and rice) (WANG DALI, ZHU XINRU, 1996). The extract reduced by 23% of the length of the wheat root (WANG DALI, ZHU XINRU, 1996).

A study conducted by MOLINARO F. (2016) indicated that methanol extract from *Ambrosia artemisiifolia* completely inhibited cherry and radish germination.

BRUNCKNER DJ (1998) studied the influence of the extracts from the leaves, inflorescences and achenes of *Ambrosia artemisiifolia* on the plants of *Amaranthus hypochondriacus*, *Trifolium pratense*, *Sinapis alba* and *Triticum aestivum*. The ragweed had significant inhibitory effects, at higher concentrations, on the germination and growth of all tested species. Extracts from leaves and inflorescences had almost the same inhibitory potential, while the extract of achenes, especially at lower concentrations, did not significantly influence the treated seeds (BRUNCKNER DJ., 1998).

Compounds released by the ragweed can affect soil microorganisms, such as bacteria and fungi. However, very few things are known about the direct effect and antimicrobial activity of the compounds produced by *Ambrosia artemisiifolia*, such as isabeline (is a sesquiterpene dilactone), on soil microorganisms (MOLINARO et al. 2016).

The inhibitory activity of isabeline as a pure compound in seed germination of different plant species has been observed recently, the results could be used in biological weed control (MOLINARO et al. 2016, GEORGIEVA N. et al. 2018).

Regarding the action of isabeline on microorganisms, no antifungal activity was shown; but revealed strong antimicrobial activity against bacteria *Paenibacillus* sp., and the human pathogen *Staphylococcus aureus* resistant to many drugs, indicating that metabolites released by *Ambrosia artemisiifolia* can be explored as a source of new compounds needed to fight MOLINARO agents and cologens. 2016).

The purpose of this study was to highlight the allelopathic effects of the *Ambrosia artemisiifolia* species on crop plants (maize) and spontaneous plants (*Amaranthus*).

## MATERIAL AND METHODS

The fresh leaves of Ambrosia artemisiifolia were collected (May 24), from the Didactical Facility of the University of Agricultural Sciences and Veterinary Medicine of the Banat "King Michael I of Romania" from Timisoara, washed and dried.

Research was conducted under laboratory conditions. The experience included 4 variants in 3 replicates, both for maize and for redroot pigweed. 25 g of material mixed with 800 ml of distilled water was used to prepare the extracts, they were placed on the magnetic stirrer for six hours, after which filtration was carried out.

The extracts used in the study differed by the three concentrations: 30%; 60% and 90%.

The four treatments differ throughout extract concentration used:

T-1 : Untreated (distilled water)

T-2 : hydro-extract based on leaves of *Ambrosia artemisiifolia* 30%

T-3 : hydro-extract based on leaves of *Ambrosia artemisiifolia* 60%

T-4 : hydro-extract based on leaves of *Ambrosia artemisiifolia* 90%

The maize seeds were treated with 6 ml of the respective extract, 12 ml for redroot pigweed seeds.

The maize and redroot pigweed seeds were placed on a filter paper in a Petri dish (10 seeds maize/Petri dish; 50 seeds pigweed/Petri dish).

Petri dishes were exposed to 12 hours light, at a temperature of 22 ± 2 ° C, for 7 days. After the treatments were applied, the germination of the maize seeds, the length of the roots and the height of the plants were assessed. In variants with *Amaranthus retroflexus* only the percentage of germination was determined.


seeds pigweed


extract concentration


seeds pigweed and maize


material mixed

magnetic stirer


trial setup

**RESULTS AND DISCUSSIONS**

It was observed that maize seeds showed germination rates ranging from 90% to 100%. The extracts from the leaves of *Ambrosia artemisiifolia* in the concentration of 60% and 90% reduced germination of maize seeds by 10% compared to the control. The 30% concentration of *Ambrosia artemisiifolia* extract did not inhibit germination of maize seeds (figure 1).

Studies performed by BÉRES et all. (2001) regarding the influence of hydro, alcoholic and acetone extracts from *Ambrosia artemisiifolia* showed that soybean seeds germination was diminished by 20-5% and 20-40% of corn, sunflower and pea. KAZINCZI et al (2008) obtained similar results.

The tests conducted by BONEA (2018) showed that al extracts used (roots, stems and leaves) inhibited corn seed germination and exerted a influence on plant growth.

The corn root length was between 2.39 cm - 5.06 cm. In the control variant (treated with distilled water) corn kernels showed an average length of 3.42 cm, the maximum value being recorded in the variant treated with 30% extract. Corn roots showed a reduction of 1.25-1.27 cm in variants treated with 60% and 90% extract, compared to the control.

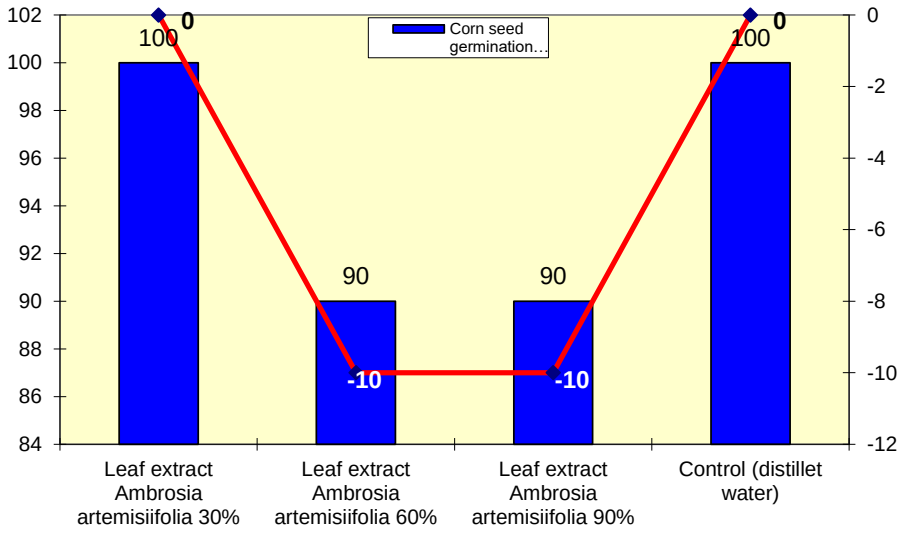



Figure 1 - Results of excracts from *Ambrosia artemisiifolia* on the germination of maize seeds

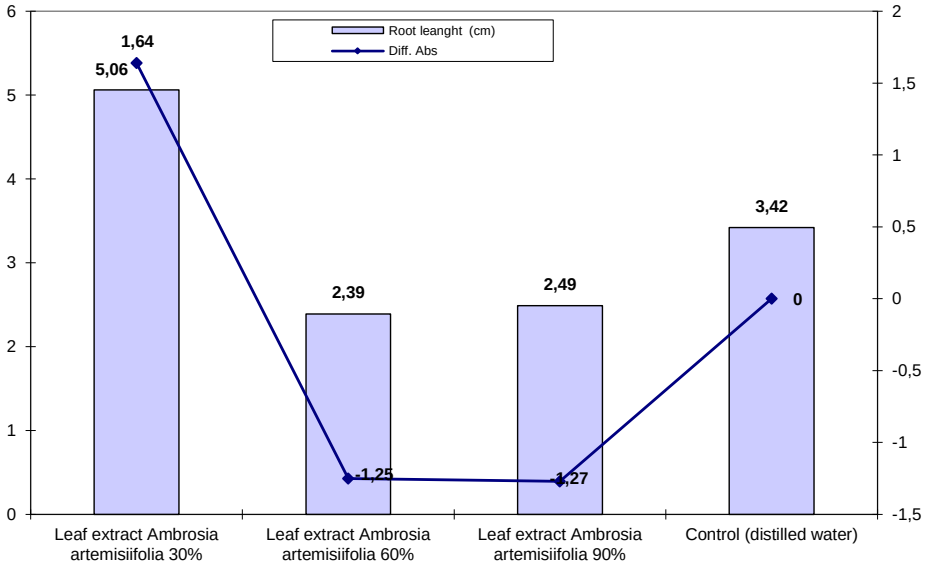



Figure 2 - Graphical representation of recorded data on the "root length" in variants treated with common ragweed extract

The height of the maize plants, at 7 days from the placement of the experience, presented values of 1.17-3.30 cm. Corn plants showed a reduced height of 0.83 cm in variants watered with 90% extract.

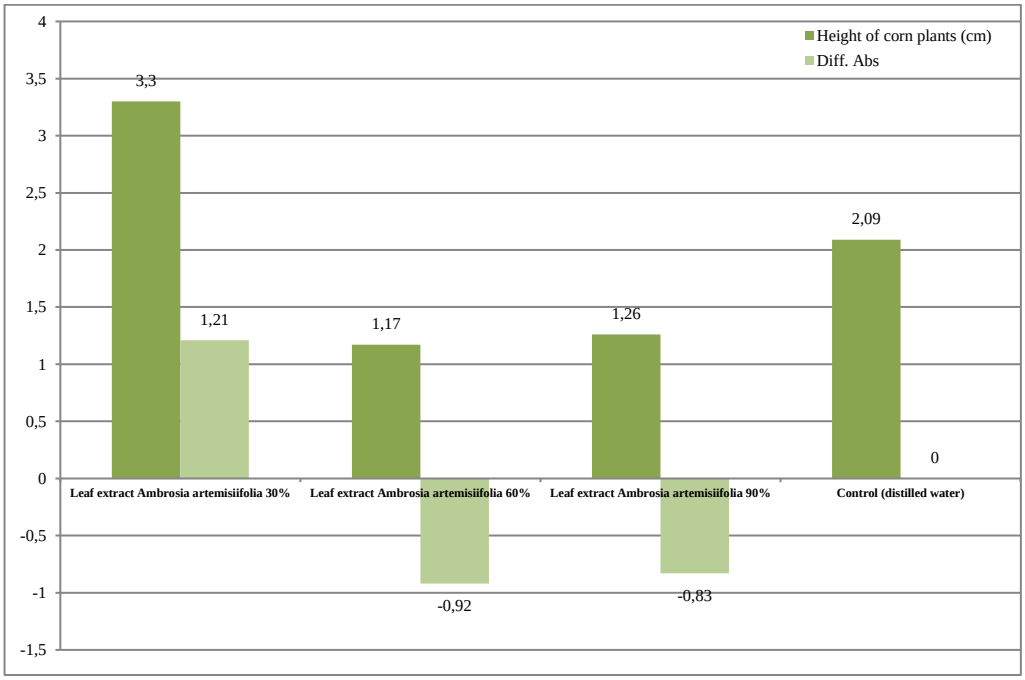



Figure 3 - Corn plant height results in experimental variants

The extract from *Ambrosia artemisiifolia* 60% inhibited the height of maize plants at most. The studies carried out showed that the variants treated with leaf extract of *Ambrosia artemisiifolia* 30% determined the stimulation of the root length and the "height of the plant" character.

*Table 1*

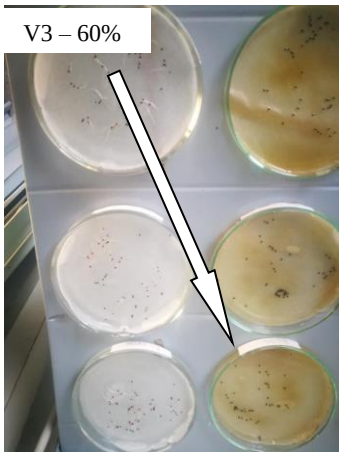
*Amaranthus retroflexus* seeds germination in variants treated with extract of *Ambrosia artemisiifolia*

| Plant | **Control** | **Concentration** | | |
|---|---|---|---|---|
| | | **30%** | **60%** | 90% |
| *Amaranthus retroflexus* | 80% | 7,5 | 2,5 | 10 |
| | | 7,5 | 2,5 | 2,0 |
| | | 2,5 | 20 | 2,5 |
| | Mean | 5,83 | 8,33 | 4,83 |

Studies on the influence of extracts of common ragweed on the germination of *Amaranthus retroflexus* seeds revealed a very significant decrease (germination of 4.83% - 8.33%). In the control variant seed germination was 80%.

Our results showed that *Ambrosia artemisiifolia* in various concentrations inhibited corn germination and plant growth (length of radicles, plant heights), even if in some variants (where extract concentration 30% was used) some stimulatory effects appeared in growing initiation. Considering the allelopathic effect of species Ambrosia *artemisiifolia* trough plant growth and yield reduction, also the impact upon human health, we can affirm that allelopathy plays an important role in species invasivity.

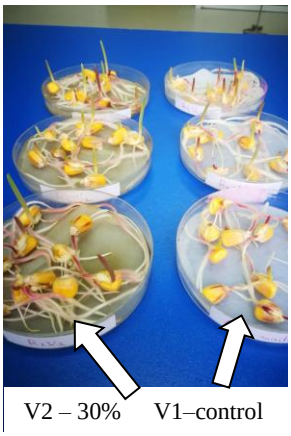

V1 - control

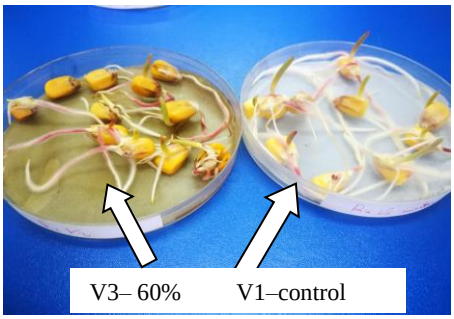

V3 – 60%


V4 – 90%


V2 – 30%


V4– 90%


V2 – 30%
V1–control


V3– 60%
V1–control

## CONCLUSIONS

The following conclusions have been drawn from the researches:

The germination of corn seeds in the experimental variants was staggered.

The maximum germination percentage was recorded 5 days after the placement of the experience.

The leaf extract of *Ambrosia artemisiifolia* in a concentration of 30% showed a stimulating effect on: the length of the corn root and the height of the plants.

Concentrations of 60% and 90% reduced seed germination, root length and maize plant height, but the differences between the two concentrations were not significant.

The extracts from common ragweed have a strong inhibitory effect on the germination of the seed.

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