ASCLEPIAS SYRIACA: A STUDY ON THE EFFECTS OF AQUEOUS EXTRACTS ON GERMINATION AND GROWTH OF *HELIANTHUS ANNUUS* PLANTS

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Abstract. *Asclepias syriaca was introduced in Romania as ornamental plant in XIX century. In present, this species can be encountered in various habitats such as meadows, forest edge, lakes shore, irrigation canals, edge of roads, various crops and orchards, tending to establish itself in agricultural crops. Asclepias syriaca owns a set of characteristics (high multiplication capacity, spreading capacity, resistance to abiotic stress factors, contains allelopathic substances) from which its competitiveness results. Its presence, more frequently, in anthropic ecosystems, including sunflower ecosystem create the basis for establishing the purpose of this study. The trials placed under laboratory conditions followed the interaction between Asclepias syriaca extracts based on leaves, stems and roots and germination, growth and early development of Helianthus annuus plants. The solvent used for extracts preparation was distilled water. As treatments we included â 9 extracts: roots (10%, 20%, 30%), steams (10%, 20%, 30%) and leaves (10%, 20%, 30%). The data obtained reveled that Asclepias syriaca extracts had an inhibitory effect on germination, growth and Helianthus annuus development. Extract based on rots of Asclepias syriaca reduced at highest the plants height, of fresh biomass and on sunflower seed germination. The seed germination (mean of nine variants) treated with extracts of Asclepias syriaca being 50% compared with control variant (86,67%). When treated with leaf aqueous extracts the sunflower plants exhibited the shortest height (2.08 – 3.65 cm), with significant differences compared to the control (7.24 cm). the plants in variants treaded with extract at 30% were the most affected, physiological processes being significant affected. The statistical data recorded enforce the understanding of yield loses from Asclepias syriaca infested crops.*

Keywords*: Asclapias syriaca, Helianthus annuuss*, germation, biomass, plant height

INTRODUCTION

The perennial species *Asclepias syriaca* is native to North America (FOLLAK, 2021, ȘTEF, 2022; ȘTEF, 2023). Was introduced to Europe in 1629 (GARTNER, 1979, cited by MIHAI et al., 2024), respectively 1836 in Romania (for the first time in the Moldova region) (SÎRBU and OPREA, 2011). Now, *Asclepias syriaca* is considered one of the most problematic invasive plant species in Romania (LAZZARO et al., 2020, URZICEANU et al., 2021, ȘTEF 2021). Occupies natural, semi-natural and artificial habitats in Romania (STEF et al., 2021, OPREA, 2021).

The research papers published indicate that *Asclepias syriaca*, endanger the biodiversity of natural habitats and their ecology (NADASY et al., 2018, BAKACSY et al, 2024, MEINHARDT et al., 2024). The competitiveness of the species is highlighted, in the research published by MEINHARDT et al. (2024), trough allelopathy. Through this process, plants influence, positively or negatively, the growth and development of surrounding plants, producing and releasing chemical substances into the environment (through leaching, volatilization, decomposition) (ȘTEF, 2017, CHIFANET AL., 2019, KINCEL et al., 2019, MYRES et al., 2019). KAZINCZI et al. (2004), CSISZÁR et al. (2013) and KELEMEN et al. (2016) explain the competitiveness.

The observations performed by KELEMEN et al. (2016), CSISZÁR et al. (2013) underline that its competitivity is given by high height, shading canopy, vegetative spread, drought tolerance and allelopathic potential.

The allelopathy of the *Asclepias syriaca* species was first reported in 1956 (LE TOURNEAU et al. 1956), followed by RASMUSSEN in 1975. Beginning with 2000, the community of researchers covering the topic, the allelopathic potential of the species, has increased (NARWAL et al. 2000, BERES and KAZINCZI, 2000).

The report of LE TOURNeau shows that the aqueous extract inhibited the germination of wheat seeds, RASMUSSEN found that the hydrophilic extract of the leaves inhibited *Sorghum bicolor*, and BERES and KAZINCZI reported inhibited germination of sunflower seeds, soybean, and corn.

The studies performed by CAMPBELLON on chemical composition of *Asclepias syriaca* exerted the presence in whole plant of polyphenols, hydrocarbon polymers, and oils (POPOV et al., 2021). Cardenolic glycosides (syriosid, syriogenin, xysmalogenin, syriobiosid, xysmalogenin, desglukouzarin, uzarigenin, uzarin), protein, phytoserols and vitamin C being identified in all organs of the plant.

Considering the fact that in the last ten years, *Asclepias syriaca* has been present and more common in agroecosystems in Romania, the aim of this study was to determine if aqueous extracts from roots, stems and leaves of *Asclepias syriaca* have a negative effect on seed germination, growth and development of *Helianthus annuus* seedlings.

MATERIAL AND METHODS

Preparation of extracts

To explore the allelopathic potential of the invasive species *Asclepias syriaca*, fresh plant material was harvested from the edge of the Dumbrăvița forest (45.803611, 21.265703) (figure 1) to avoid possible herbicide residues and impact on the results. The plants were harvested at the beginning of au October – at maturity.

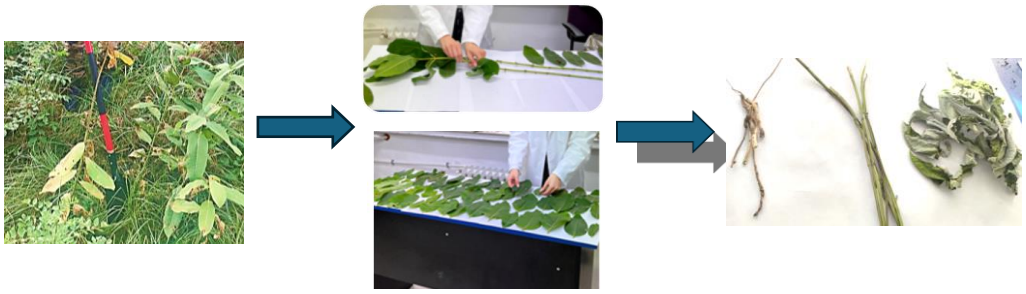

Fig. 1. Harvesting plant material, samples preparation and drying (at room temperature) (photo Stef Ramona)

After harvest the sample were transported to the laboratory and organs separation and drying at room temperature followed (figure 1). The dried samples were milled and the process was followed by weighing 60 gram of each sample the added the solvent (800 ml distilled water). This suspension was stirred for 24 hours then filtered (figure 2). The dilutions were: the crude extract was considered as 100%, then: 10 ml for 10% dilution on top was added 90 ml distilled water; 20 ml for 20% dilution with addition of 80 ml distilled water; 30 ml 30% dilution with addition of 70 ml distilled water.

Fig. 2. The steps taken to prepare the extracts (weighing, applying the solvent, stirring the solution, filtering) (photo Stef Ramona)

Trial setup

The experiment was conducted under laboratory conditions (22.05.2024) and targeted test plant was *Helianthus annuus*. To observe the interference of *Asclepias syriaca* extracts with *Helianthus annuus* 5seeds/pot were placed. Sterilized sand was used as substrate. The seeds were also sterilized trough immersion in hypochlorite for 10 minutes. The trial consisted in 10 treatments in three replications, in order to enable statistical analysis (Figure 3): V1 = control = distilled water; V2 = aqueous extract from the roots of *Asclepias syriaca* 10% (AWEASR 10%); V3 = aqueous extract from the roots of *Asclepias syriaca* 20% (AWEASR 20%); V4 = aqueous extract from the roots of de *Asclepias syriaca* 30% (AWEASR 30%); V5 = aqueous extract from the stems of *Asclepias syriaca* 10% (AWESAS 10%); V6 = aqueous extract from the stems of *Asclepias syriaca* 20% (AWESAS 20%); V7 = aqueous extract from the stems of *Asclepias syriaca* 30% (AWESAS 30%); V8 = aqueous extract from the stems of *Asclepias syriaca* 10% (AWELAS 10); V9 = aqueous extract from leaves of *Asclepias syriaca* 20% (AWELAS 20); V10 = aqueous extract from leaves of *Asclepias syriaca* 30% (AWELAS 30).

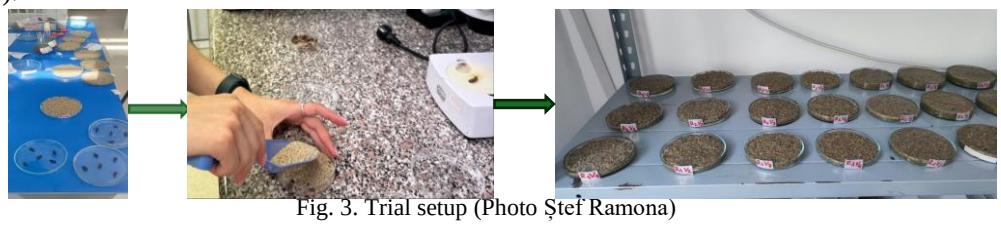

Fig. 3. Trial setup (Photo Ștef Ramona)

After the experiment was set, the variants were treated with 60 ml of extract, applied as 20 ml at setup, 20 ml three days after setup, and 20 ml five days after setup. Starting with the 7th day, the variants were watered with distilled water. For the control untreated variant, 60 ml of distilled water was used during the first five days. The Petri dishes were kept in the laboratory under 12 hours of light and a temperature of 22 ± 2°C for 12 days.

Morphological Measurements

Morphological measurements were performed 12 days after the experiment setup. The parameters measured for the plants included: plant height determined by measuring the underground and aboveground parts using a graduated ruler and fresh biomass determined using an analytical balance (Figure 4).

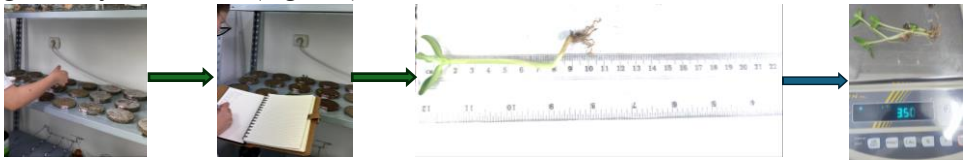

Fig. 4. Observations made during the experiment (Photo Ștef Ramona)

Data analysis

The germination rate (%), height and weight of sunflower plants were determined for each treatment.

The germination rate was determined according to the formula:

PG = (Germinated Seeds /Total Seeds) x 100

PI % = Germinated Seeds (%) in the treated variant - Germinated Seeds (%) in the untreated control variant/ Germinated Seeds (%) in the treated variant multiplied by 100

The data were analyzed using ANOVA t and the Tukey's test (HSD), along with a post-hoc test used to compare all pairs of means to identify significant differences between them (CHIȘ, 2011).

RESULTS AND DISCUSSIONS

Applying the nine aqueous extract based on *Asclepias syriaca* has been observed that *Helianthus annuus* exerted different vulnerability levels. Table 1 shows that germination rat of the seeds was reduced by up to 50% (mean percentage of treated variants) compared with the control. The average germination rate of the seeds ranged between 13.33% (AWEASR 30%) up to 73.33% (AWELAS 10%). The standard deviation of 22.62% The standard deviation of 22.62% highlights the existence of a significant variability among germination rates achieved in treated variants. The germination rate of sunflower seed was strongly inhibited when root extract AWEASR 30% was applied, where the minimum germination rates were recorded.

The highest germination rate (86.67%) was reached when only distilled water was applied. (Table 1). Analyzing the three calculated percentages (25%, 50%, 75%) comes out that: in 25% of variant treated with *Asclepias syriaca* extract the germination was lower than 43.33% (AWEASR 20%; AWEASR 30%; AWESAS 30%); in 50% of variants a lower percent than 53.33% (AWEASR 10%; AWEASR 20%; AWEASR 30%; AWESAS 20%; AWESAS 30%; AWELAS 30%) was recorded; and in 75% from variants the germination percent was lower than 66.67% (Table 1).

Table 1

The interference of allelopathic extracts from *Asclepias syriaca* on the germination rate of *Helianthus annuus* seeds

Treatment	Inhibition (%) - PI	Germination (%)	Absolute Difference
AWELAS 10%	18	73.33	-13.33
AWELAS 20%	44	60	- 26.67
AWELAS 30%	62.55	53.33	-33.33
AWESAS 10%	30	66.67	-20
AWESAS 20%	62.5	53.33	- 33.33
AWESAS 30%	116.67	40	-46.67
AWEASR 10%	62.5	53.33	-33.33
AWEASR 20%	333.33	20	-66.67
AWEASR 30%	550	13.33	-73.33
Control	0	86.67	-
count	9	10	
mean	142.17	52.00	
std	180.34	22.62	
min	18	13.33	
25%	44	43.33	
50%	62.5	53.33	
75%	116.67	65.00	
max	550	86.67	

In respect of inhibition effect (%, PI) of extracts on germination the differences were considerable indicating high significant differences among treatments (dst – 180.34%) (Figure 5). The root extracts AWEASR 20% and AWEASR 30% exerted inhibiting percentage of 333.3% and 550%. Meanwhile the root extract AWEASR 10% was much more inferior (62.5%) as other two

concentrations (20%, 30%) (Figure 5). When leaves and stems extract were applied the mean percentage of sunflower seeds inhibition was 51.12% much more inferior than mean of experience. (142.17%).

Statistical analysis of germination percentages shows that the treatments reduce them with 33% related cu untreated control. The highest germination rate was achieved in control variant (86.67%) being considered as reference point (without absolute difference). The treatments recording differences under -20% (AWELAS 10%, AWESAS 10%) influenced at lowest the sunflower seed germination (Figure 6). The extracts AWEASR 30%, AWEASR 20%, AWEASR 30% exerted severe effects on germination rate, absolute differences laying between (-46.67%) – (-73.33%). Leaves aqueous extracts of *Asclepias syriaca* had a lowest interference in the *Helianthus annuus* seeds germination process, absolute difference between (-13.33) – (-33.33).

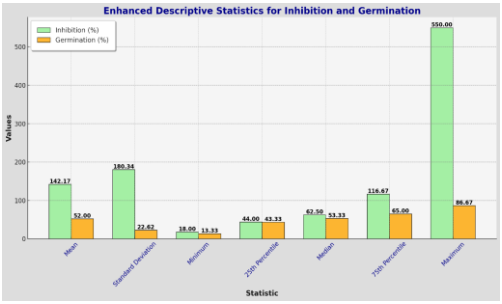

Fig. 5. Statistical analysis of germination and inhibition percentage

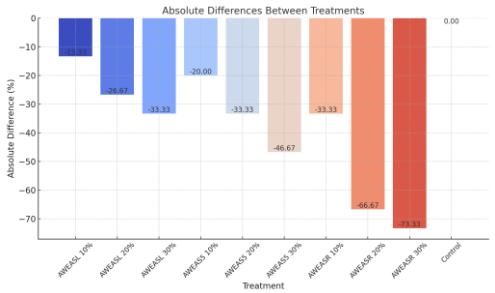

Fig. 6. Absolute differences between treatments

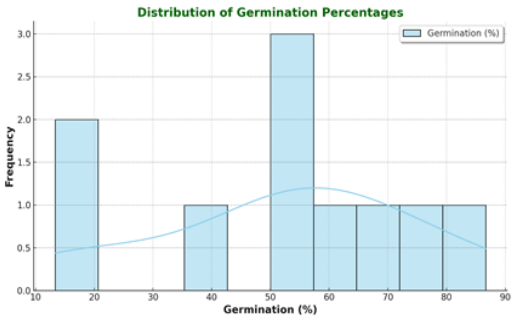

Fig. 7. Histogram of the distribution of germination percentages

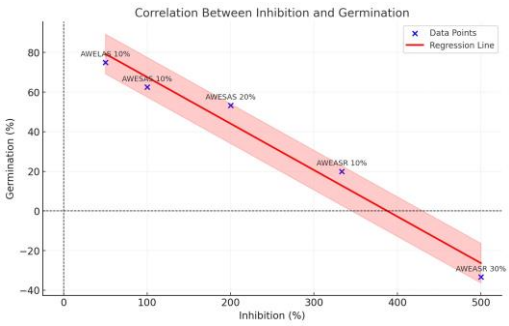

Fig. 8. Correlation between germination and inhibition percentages

The histogram (Figure 7) shows that the germination was influenced by plant organ and higher extract concentrations. The most inhibiting extracts were those based on roots, statement based on inhibition and germination correlation. Statistical analysis (correlation coefficient Pearson: -0.925 and p:0.00035) underline the presence of a very negative correlation, indicating that as the inhibition percentage increases, the germination percentage decreases significantly (Figure 8).

ANOVA analysis in respect of *Asclepias syriaca* aqueous extracts on sunflower plant growth, underlined the existence of significant differences (Table 2). Sunflower plant height, at12 after trial setup ranged between 2.07 cm (AWEASR 30%) and 7.24 cm (control). The growth parameters in early development stages of crops are very important and defines the relations between weeds and crops (SIKORA and BERENJI, 2008). It is well known that the allelochemical compounds isolated from different plant organs have inhibitory or

biostimulatory activity on recipient plants and their intensity relays on concentrations (SIKORA and BERENJI, 2008).

Table 2

Results regarding the interference of aqueous extracts from *Asclepias syriaca* on the height of *Helianthus annuus plants*

Treatment	Height sunflower plants (cm)			Average height of sunflower plants (cm)	*p-value*
	R1 (cm)	R2 (cm)	R3 (cm)		
AWEASR 10%	2.00	3.00	1.5	2.17	0.0002^{***}
AWEASR 20%	3.00	3.56	4.38	3.65	0.0083^{**}
AWEASR 3%	2.15	2.00	2.10	2.07	0.0001^{***}
AWESAS 10%	6.12	5.00	4.62	5.25	0.3574^{-}
AWESAS 20%	5.00	8.50	6.80	6.77	0.9998^{-}
AWESAS 30%	4.70	5.20	5.30	5.07	0.2563^{-}
AWELAS 10%	5.12	5.79	5.62	5.07	0.2563^{-}
AWELAS 20%	7.21	4.96	8.50	6.89	1.000^{-}
AWELAS 30%	5.80	4.68	5.00	5.16	0.3059^{-}
Control	8.25	7.62	5.85	7.24	-

F-statistic 10.08, p<0.0001

Leaves extracts (AWELAS) exerted a reduced effect on plant height, especially at a concentration of 20%, where a mean value of 6.89 cm was recorded. Growth inhibition in variant treated with stems extracts (AWESAS) was moderate, the recorded heights were 5.07 - 6.77 cm. the results are aligned with those reported by KHAN (KHAN et al., 2018) and shows tah the stems content of alkaloids and terpenoids is moderate.

The strong inhibiting effect on height growth of sunflower plants was recorded in variants treated with root extracts (AWEASR 20%, AWEASR 30%) (2.07-3.65 cm). Similar results were published by CHUNG (CHUNG et al., 2015) revealing the high inhibition potential of root extracts trough the fact that these plant organs are containing saponins, tannins and small quantities of biostimulatory substances.

The process of *Helianthus annuus* plant growth was strongly reduced by extract applied at 30% (Table 2). Sharma explain the phytotoxicity effect induced by higher extract concentrations trough accumulation of excess secondary products (SHARMA et al., 2017).

Post-hoc comparisons between variants treated with *Asclepias syriaca* extracts and *Helianthus annuus* plant height are revealed Table 3. The statistical analysis (Tukey test) highlights the presence of very significant differences between plant height in treated variants with AWEASR 30% and AWEASR 10% and plant heights in variant treated with leaves and stem extracts, AWELAS 20%, AWESAS 20% ($p < 0.001$). The plants treated with roots extract were very significantly lower than the plants in control variant. Plant heights achieved in variants treated with root extracts (AWEASR 30%, AWEASR 20%, AWEASR 10%) and these obtained in variants treated with stem extracts (AWESAS 10%, AWESAS 20%) showed a moderate significant difference.

Plant heights registered in variants treated with leaves extracts was not statistically differentiated from the variants treated with stem extracts. We meet same picture when compared with results obtained in control variant. Table 3 shows that there are no statistically differences between all treatment pairs (Figure 9).

Table 3

Comparative analysis of allelopathic extracts from *Asclepias syriaca* on the height of *Helinathus annuus* plants (Tukey test)

Treatment 1	Treatment 2	Mean Diff.	p-value (adjusted)	Lower	Upper
AWEASR 30%	Control	5.1567	0.0001***	2.257	8.0563
AWEASR 10%	Control	5.0733	0.0002***	2.1737	7.973
AWEASR 10%	AWELAS 20%	4.7233	0.0004***	1.8237	7.623
AWEASR 30%	AWELAS 20%	4.6833	0.0005***	1.7837	7.583
AWEASR 10%	AWELAS 20%	4.6	0.0006***	1.7004	7.4996
AWEASR 20%	Control	3.5933	0.0083**	0.6937	6.493
AWEASR 10%	AWELAS 10%	3.3433	0.0161*	0.4437	6.243
AWEASR 30%	AWESAS 10%	3.1633	0.0257*	0.2637	6.063
AWEASR 20%	AWESAS 20%	3.12	0.0287*	0.2204	6.0196
AWEASR 10%	AWESAS 10%	3.08	0.0318*	0.1804	5.9796
AWEASR 10%	AWELAS 30%	2.9933	0.0396*	0.0937	5.893
AWEASR 30%	AWESAS 30%	2.9833	0.0406*	0.0837	5.883
AWEASR 10%	AWESAS 30%	2.9	0.05*	0.0004	5.7996
AWESAS 30%	Control	2.1733	0.2563-	-0.7263	5.073
AWELAS 30%	Control	2.08	0.3059-	-0.8196	4.9796
AWESAS 10%	Control	1.9933	0.3574-	-0.9063	4.893
AWELAS 10%	Control	1.73	0.5395-	-1.1696	4.6296
AWELAS 30%	AWESAS 20%	1.606	0.6316-	-1.293	4.5063
AWEASR 20%	AWESAS 10%	1.6	0.6366-	-1.2996	4.4996
AWESAS 10%	AWESAS 20%	1.52	0.6954-	-1.3796	4.4196
AWEASR 10%	AWEASR 20%	1.48	0.7239-	-1.4196	4.3796
AWEASR 20%	AWESAS 30%	1.42	0.765-	-1.4796	4.3196
AWELAS 10%	AWELAS 20%	1.38	0.7911-	-1.5196	4.2796
AWELAS 10%	AWESAS 20%	1.2567	0.8627-	-1.643	4.1563
AWESAS 20%	Control	0.4733	0.9998-	-2.4263	3.373
AWELAS 20%	Control	0.35	1-	-2.5496	3.2496
AWELAS 30%	AWESAS 10%	0.0867	1-	-2.813	2.9863
AWEASR 10%	AWEASR 30%	-0.0833	1-	-2.983	2.8163
AWELAS 30%	AWESAS 30%	-0.0933	1-	-2.993	2.8063
AWELAS 20%	AWESAS 20%	-0.1233	1-	-3.023	2.7763
AWESAS 10%	AWESAS 30%	-0.18	1-	-3.0796	2.7196
AWELAS 10%	AWESAS 10%	-0.2633	1-	-3.163	2.6363
AWELAS 10%	AWELAS 30%	-0.35	1-	-3.2496	2.5496
AWELAS 10%	AWESAS 30%	-0.4433	0.9999-	-3.343	2.4563
AWEASR 20%	AWEASR 30%	-1.5633	0.6637-	-4.463	1.3363
AWELAS 20%	AWESAS 10%	-1.6433	0.6042-	-4.543	1.2563
AWESAS 20%	AWESAS 30%	-1.7	0.5618-	-4.5996	1.1996
AWELAS 20%	AWELAS 30%	-1.73	0.5395-	-.4.6296	1.1696
AWELAS 20%	AWESAS 30%	-1.8233	0.4714-	-4.723	1.0763

P-value and confidence intervals (confidence intervals corrected using the Tukey method)> * p<0.05; ** p<0.01; *** p<0.001

The regression presented in figure 10, reveal the direct relation between extract concentration and plant heights. Leaf extracts exerted a weak relationship between

concentration increase and sunflower plants height. The influence of stem extracts on plant height remains almost the same in all three concentrations (30%, 20%, 10%) (R^2 = 0.00).

Leaves extracts exerted a slightly increases of inhibition plant growth process once the concentration increases (R^2 = 0.11), but the relationship remains weak. The results turned to be very different from those presented above when analyzing the root extracts effect, the negative impact increases significantly once the concentration increases (R^2 = 0.25) (figure 10).

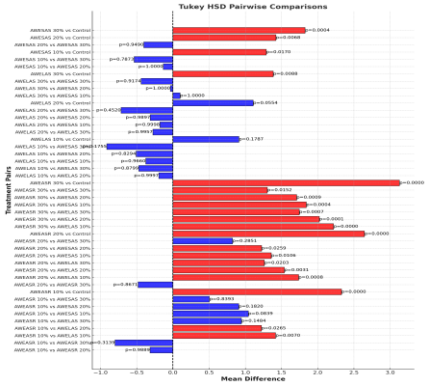

Fig. 9. Analysis of mean differences between treatments (Tukey HSD)

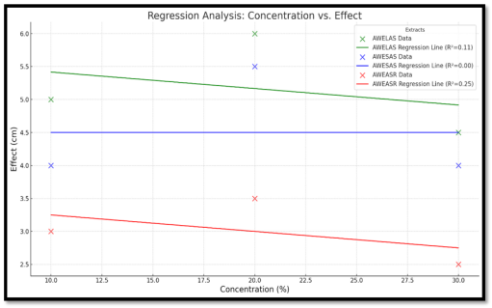

Fig. 10. Regression between extract concentration and sunflower plant height

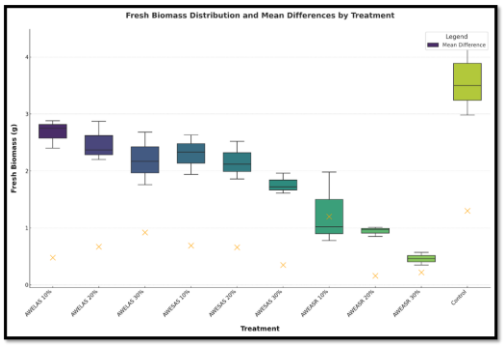

Fig. 11. Fresh biomass and distribution analysis according to allelopathic extract differences

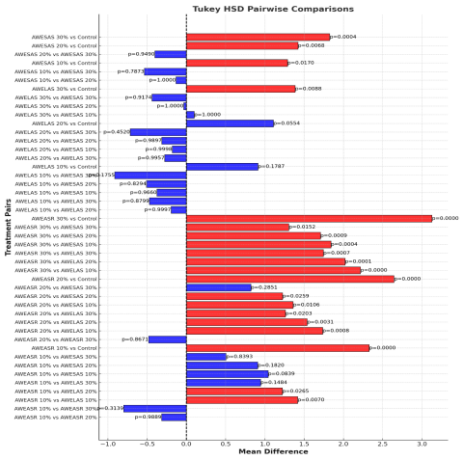

Fig. 12. Pairwise Comparisons of Treatments: Tukey HSD Test

At 12 DAA of vegetal extracts, sunflower plants exerted a mean value of weight between 2.20 g – 3.59 g. Most vigorous plants were observed in untreated control variant (figure 11). The obtained biomass from leave extract 20% treated variant represented 74.63% from the control variant. The difference being not significant. The *Asclepias syriaca* root extract when applied as 20% and 30% concentrations decreases the biomass with 1.11 g respectively 1.38 g (figure 11). *Asclepias syriaca* stem extracts determined the decrease of sunflower plants weight when compared with control variant (distilled water). The biomass of plant treated with stem extracts ranged between 1.76-2.30 g.

Table 4

Tukey HSD analysis of the results regarding the fresh biomass of *Helianthus annuus* obtained in the variants treated with allelopathic extracts

Treatment 1	Treatment 2	Mean diff.	p-adj.	Lower	Upper
AWEASR 10%	AWEASR 20%	-0.3167	0.9889	-1.4394	0.8061
AWEASR 10%	AWEASR 30%	-0.8	0.3139	-1.9228	0.3228
AWEASR 10%	AWELAS 10%	1.4167	0.007**	0.2939	2.5394
AWEASR 10%	AWELAS 20%	1.22	0.0265*	0.0972	2.3428
AWEASR 10%	AWELAS 30%	0.9433	0.1484-	-0.1794	2.0661
AWEASR 10%	AWESAS 10%	1.04	0.0839-	-0.0828	2.1628
AWEASR 10%	AWESAS 20%	0.9067	0.182	-0.2161	2.0294
AWEASR 10%	AWESAS 30%	0.5033	0.8393	-0.6194	1.6261
AWEASR 10%	Control	2.3267	0***	1.2039	3.4494
AWEASR 20%	AWEASR 30%	-0.4833	0.8671-	-1.6061	0.6394
AWEASR 20%	AWELAS 10%	1.7333	0.0008***	0.6106	2.8561
AWEASR 20%	AWELAS 20%	1.5367	0.0031**	0.4139	2.6594
AWEASR 20%	AWELAS 30%	1.26	0.0203*	0.1372	2.3828
AWEASR 20%	AWESAS 10%	1.3567	0.0106*	0.2339	2.4794
AWEASR 20%	AWESAS 20%	1.2233	0.0259*	0.1006	2.3461
AWEASR 20%	AWESAS 30%	0.82	0.2851	-0.3028	1.9428
AWEASR 20%	Control	2.6433	0***	1.5206	3.7661
AWEASR 30%	AWELAS 10%	2.2167	0***	1.0939	3.3394
AWEASR 30%	AWELAS 20%	2.02	0.0001***	0.8972	3.1428
AWEASR 30%	AWELAS 30%	1.7433	0.00071***	0.6206	2.8661
AWEASR 30%	AWESAS 10%	1.84	0.0004***	0.7172	2.9628
AWEASR 30%	AWESAS 20%	1.7067	0.0009***	0.5839	2.8294
AWEASR 30%	AWESAS 30%	1.3033	0.0152*	0.1806	2.4261
AWEASR 30%	Control	3.1267	0***	2.0039	4.2494
AWELAS 10%	AWELAS 20%	-0.1967	0.9997-	-1.3194	0.9261
AWELAS 10%	AWELAS 30%	0.4733	0.8799-	-1.5961	0.6494
AWELAS 10%	AWESAS 10%	-0.3767	0.966-	-1.4994	0.7461
AWELAS 10%	AWESAS 20%	-0.51	0.8294-	-1.6328	0.6128
AWELAS 10%	AWESAS 30%	-0.9133	0.1755-	-2.0361	0.2094
AWELAS 10%	Control	0.91	0.1787-	-0.2128	2.0328
AWELAS 20%	AWELAS 30%	-0.2767	0.9957-	-1.3994	0.8461
AWELAS 20%	AWESAS 10%	-0.18	0.9998-	-1.3028	0.9428
AWELAS 20%	AWESAS 20%	-0.3133	0.9897-	-1.4361	0.8094
AWELAS 20%	AWESAS 30%	-0.7167	0.452-	-1.8394	0.4061
AWELAS 20%	Control	1.1067	0.554-	-0.0161	2.2294
AWELAS 30%	AWESAS 10%	0.0967	1-	-1.0261	1.2194
AWELAS 30%	AWESAS 20%	-0.0367	1-	-1.1594	1.0861
AWELAS 30%	AWESAS 30%	-0.44	0.9174-	-1.1594	-
AWELAS 30%	Control	1.3833	0.0088**	0.,2606	2.5061
AWESAS 10%	AWESAS 20%	-0.1333	1-	-1.2561	0.9894
AWESAS 10%	AWESAS 30%	-0.5367	0.7873-	-1.6594	0.5861
AWESAS 10%	Control	1.2867	0.017*	0.1639	2.1094
AWESAS 20%	AWESAS 30%	-0.4033	0.949-	-1.5261	0.7194
AWESAS 20%	Control	1.42	0.0068**	0.2972	2.5428
AWESAS 30%	Control	1.5233	0.0004***	0.7006	2.9461

Note. P-value and confidence intervals (confidence intervals corrected using the Tukey method): * p < 0.05, ** p < 0.01, *** p < 0.001

Sunflower plant weight was werry signifficant reduced by root extract. Tukey test reveals tha strong inhibiting character of this extract typ (Table 4) compared with the other extracts, the differences regarding plants weight being signifficant in following pairs : AWEEASR 10% : AWELAS 10%; AWEASR 10% : Control; AWEASR 20% : AWELAS 10%; AWEASR 20% : Control; AWEASR 30% : AWELAS 10%; AWEASR 30% :

AWELAS 20%; AWEASR 30% : AWELAS 30%; AWEASR 30% : AWESAS 10%; AWEASR 30% : AWESAS 20%; AWEASR 30% : Control, AWESAS 30% : Control.

The plant weight was significantly reduced in the plots treated with stem and leaves extracts as 30% concentration compared with the plant weight obtained in the plots treated with distilled water.

Tukey analise indicates moderat significant differences between plant height of th eplants treated with rhizomes extract 10% și 20% and de one observed in the plots treated with leaves and stem extracts (20%, 30%).

CONCLUSIONS

The aqueous extracts based on *Asclepias syriaca* roots exhibited the strongest effect in germination inhibition, reduction of height and biomass of *Helianthus annuus* plants, followed by the extracts based on leaves and stems.

The strongest negative effect among all three extract types studied, was exerted on the germination process followed by biomass reduction. The extracts inhibited at lowest the height growth compared with the other characters.

The inhibition effect increased along with the increase of the extract concentration.

The aqueous extract based on leaves had the lowest impact on germination process, growth and sunflower plant development compared to roots and stem extracts. The stidies regarding the allelopathy exerted by *Asclepias syriaca* needs to be continued to explore both the negative impact upon natural and man-made ecosystems and as well positive effects trough its use in ecological agriculture.

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