

ALLELOPATHIC EFFECTS OF ALLYL ISOTHIOCYANATE ON SEEDS GERMINATION ABILITY AND SEEDLING GROWTH OF *RAPHANUS SATIVUS* L.

Bandici Gheorghe^{*}, Sferle Andrada^{}, Șipoș Monica^{***}**

^{*} University of Oradea, Agronomy Department, Environmental Protection Faculty, 26 Gen. Magheru St., 410048, Oradea, Romania

^{**} University of Oradea, BSc. student in Biology, Science Faculty, 1Universitatii St., Oradea, Romania

^{***} University of Oradea, Biology Department, Science Faculty, 1Universitatii St., Oradea, Romania, corresponding author e-mail: siposmonica70@yahoo.com

Abstract

*This paper study the allelopathic effects of different dilution (0,02; 0,01; 0,005; 0,002; 0,001; 0,0005; 0,0002 and 0,0001%) allyl isothiocyanate on seeds germination ability and seedling growth of radish variety (red round, black, white and red cylindrical). The germination ability of radish seeds in all variety and experimental variants was not significantly modified. The seedlings growth of **white and red cylindrical radish** evolved in optimum conditions using all concentration of allyl isothiocyanate. In **red round and black radish** the growth of the seedlings was significantly inhibited in the concentrations of 0.01% and 0.02% allyl isothiocyanate.*

Key words: allyl isothiocyanate, radish, allelopathy

INTRODUCTION

A lot of research articles study the alelopatic effect of the watery extracts from different plants on the growth and development of other plants (Konstantinović et al., 2014; Saadaoui et al., 2014, Enping Zhang et al., 2015, Wang et al., 2016). Many researches aim at using essential oils extracted from plants for their bioactive compounds (Mutlu et al., 2010; Jibiao et al., 2010).

The essential oil make possible the dosing of the active biological substances they contain. The article is a part of an experimental studies which comprises the effects of allelopathic bioactive substances allyl isothiocyanate on seeds germination ability and seedling growth of different species (Corbu et al., 2007; Șipoș et al., 2012, Șipoș et al., 2016).

MATERIAL AND METHOD

The certified materials used in our experiments were represented by seeds with following germination ability (GA): red round radish 98%, black radish 98%, white radish 99% and red cylindrical radish 99%. The oil of allyl isothiocyanate 100% (Sigma-Aldrich) was dispersed in water by ultrasonication using an Elmasonic S-15H. 100 ml of distilled water and 0.2

ml oil were poured in an Erlenmeyer flask with a glass cork. 0.2% solution of allyl isothiocyanate was obtained after ultrasonication for 15 minutes. Using the graduated cylinders and distilled water, dilutions for all experimental variants were performed ($V_1 - 0.02\%$; $V_2 - 0.01\%$; $V_3 - 0.005\%$; $V_4 - 0.002\%$; $V_5 - 0.001\%$; $V_6 - 0.0005\%$; $V_7 - 0.0002\%$ and $V_8 - 0.0001\%$). Sterile colorless plastic casseroles were covered on the bottom with filter paper which was moistened with 25 ml of different dilution of allyl isothiocyanate or with distilled water (for control). For all experimental variants ($V_1 - V_8$) and control lots 50 seeds were placed in each casserole. The germination ability was determined in two replicates. Covered colorless casseroles were then placed in a germination cabinet at 21-23°C in the dark. After 5 day germination ability and seedling growth (root length and hypocotile height in centimeters) was determinate. Statistical analysis included: arithmetic media (M), standard deviation (sd) and Student's test with SigmaPlot 2001 software. The significance level was set at $P < 0.05$ or $P < 0.001$.

RESULTS AND DISCUSSION

The experimental results are listed in Table 1.

The germination ability of **red round radish** seeds was of 98% in the control. This value was not significantly changed in the experimental variants $V_1 - V_8$ (95%, 95%, 92%, 96%, 97%, 98%, 98% and 97%). The roots of the seedlings are susceptible to the action of the allyl isothiocyanate, their growth being significantly inhibited in 0.02% (V_1), 0.01% (V_2) and 0.005% (V_3) dilutions. The inhibition was statistically irrelevant after V_4 dilution. The increase of hypocotile was significantly inhibited in the experimental variants V_1 and V_2 . In the experimental variants $V_3 - V_8$ the growth of hypocotile is significantly or insignificantly stimulated (Table 1).

The germination of the **black radish** seeds (GA = 98%) registered following insignificantly changed in the dilution $V_1 - V_8$ of allyl isothiocyanate (94%, 96%, 98%, 95%, 98%, 98%, 98% and 96%). The roots of black radish seedlings are sensitive to the action of allyl isothiocyanate. Their growth was inhibited in the case of all experimental variants, significantly in the V_1 and V_2 . The increase of hypocotile was significantly inhibited in the experimental variants V_1 and V_2 . In the experimental variants $V_3 - V_8$ the growth of hypocotile was insignificantly inhibited (Table 1).

The germination ability of the **white radish** seeds of the control was of 99%. A value was not changed in the experimental variants $V_1 - V_8$ (96%, 98%, 99%, 99%, 97%, 98%, 98% and 99%). The growth of the seedling was stimulated in the case of all experimental variants.

The same response was registered in the seedling growth of the **red cylinder radish**. The germination ability (99%) was not significantly modified at V₁- V₈ (98%, 99%, 99%, 100%, 100%, 99%, 100% and 100%).

Table 1

Values of the procentual differences (root length and hipocotile height) in raport with control (100%) and significance level (insignificant P>0.05; significant P<0.05; strongly significant P<0.001)

Radish variety	Vo	Dilution of the allyl isothiocyanate							
		V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈
Red round	Rl	-40.19	-26	-14.31	-5.01	-3.33	-9.32	-2.08	-8.07
		P<0.001	P<0.001	P<0.001	P>0.05	P>0.05	P>0,05	P>0.05	P>0.05
	Hh	-25.16	-15.89	7.28	8.94	10.59	12.91	0.99	7.61
		P<0.001	P<0.001	P>0.05	P<0.05	P<0.05	P<0,001	P>0.05	P>0.05
Black	Rl	-39.83	-17.82	-6.45	-11.12	-5.90	-2.47	-2.47	-5.08
		P<0.001	P<0.05	P>0.05	P>0.05	P>0.05	P>0,05	P>0.05	P>0.05
	Hh	-27.92	-13.92	-6.81	-5,25	-7.15	-6.49	-9.74	-7.79
		P<0.001	P<0.001	P>0.05	P>0.05	P>0.05	P>0,05	P>0.05	P>0.05
White	Rl	12.18	26.88	22.93	32	17.92	36.37	43.18	40.86
		P<0.05	P<0.001	P<0.001	P<0.001	P<0.05	P<0.001	P<0.001	P<0.001
	Hh	0.32	9.18	5.24	6.88	12.13	17.04	16.06	10.49
		P>0.05	P>0.05	P>0.05	P>0.05	P<0.05	P<0.001	P<0.001	P<0.05
Red cylindrical	Rl	-4.03	3.38	-0.37	3.14	6.04	16.49	8.43	4.40
		P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P<0.05	P>0.05	P>0.05
	Hh	8.17	3.36	7.47	12.5	13.95	15.38	11.05	25.24
		P>0.05	P>0.05	P>0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.001

Vo-vegetative organs; Rl-root length; Hh-hipocotile height

In the radish metamorphosed root allyl isocyanate is preserve. Probably this is the motivation for that the seedling growth of radish was not seriously affected. Only red round and black radish plantlet growth was significantly inhibited at 0.01% and 0.02% allyl isothiocyanate dilution.

Our first research work was concerned with the effect of the watery extracts with allyl isothiocyanate from the horseradish metamorphosed root on the growth of other plants (Corbu et al., 2007; Şipoş et al., 2012). But the essential oil make possible the dosing of the active biological substances they contain (Ostav, 2003, Sipos et al., 2016). For example the main

chemical component of black mustard essential oil is no less than 92% allyl isothiocyanate <http://www.essentialoils.co.za/essential-oils/mustard.htm#Chemical>

CONCLUSIONS

1. In comparison to the control the germination ability of radish seeds in all variety and experimental variants was not significantly changed.
2. The seedlings growth of **white and red cylindrical radish** evolved in optimum conditions using all concentration of allyl isothiocyanate.
3. In **red round and black radish** the growth of the seedlings was significantly inhibited in the concentrations of 0.01% and 0.02% allyl isothiocyanate.

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