ALLELOPATHIC EFFECTS OF ALLYL ISOTHIOCYANATE ON CARYOPSES GERMINATION ABILITY AND SEEDLING GROWTH OF *TRITICOSECALE* WITT. AND *TRITICUM AESTIVUM* L.

Şipoş Monica [*], Bandici Gheorghe [**] , Pop Vlad [***]

[*] University of Oradea, Biology Department, Science Faculty, 1Universitatii St., Oradea, Romania, e-mail: siposmonica70@yahoo.com
[**] University of Oradea, Agronomy Department, Environmental Protection Faculty, 26 Gen. Magheru St., 410048, Oradea, Romania
[***] University of Oradea, M.Sc. student in Agronomy, Environmental Protection Faculty, 26 Gen. Magheru St., 410048, Oradea, Romania

Abstract

This paper study the allelopathic effects of different dilution (0.001; 0.002 and 0.005%) allyl isothiocyanate on caryopses germination ability and seedling growth of Triticosecale Witt. var. Tristan and Mungis and Triticum aestivum L. var. Cubus and Lukulus. The germination ability of triticale and wheat caryopsis, in the experimental varieties that had germinated, was not significantly modified in comparison to the control plants. The seedlings growth of ***Tristan variety triticale*** *evolved in optimum conditions using the concentration of 0.001% allyl isothiocyanate.* ***Mungis triticale variety and Cubus wheat variety*** *proved to be sensitive even to 0.001% dilution of allyl isothiocyanate. The 0.001% dilution of active substance concentration significantly stimulated the growth of the seedling roots of* ***Lukulus wheat variety****. Moreover, the growth of coleoptile and of the first leaflets was significantly stimulated from a statistical standpoint. The boundary between the stimulatory and inhibitory concentrations for each species and variety should be precisely determined.*

Key words: allyl isothiocyanate, *Triticum*, *Triticosecale*, allelopathy

INTRODUCTION

The organic farming system, which mainly relies on a thorough knowledge of the interactions that occur between different plants and their biological mechanisms, is becoming more and more conspicuous in the world. It is expected that the chemical fertilizers will be strictly limited and replaced with some complex natural products derived from allelopathic plants.

The article is part of an complex experimental studies which comprises the effects of allyl isothiocyanate on seeds germination ability and seedling growth of different species (Corbu et al., 2007; Şipoş et al., 2012).

This paper study the allelopathic effects of different dilution (0.001; 0.002 and 0.005%) allyl isothiocyanate on caryopses germination ability and

seedling growth of *Triticosecale* Witt. var. Tristan and Mungis and *Triticum aestivum* L. var. Cubus and Lukulus.

MATERIAL AND METHOD

The certified materials used in our experiments were represented by cereals cariopses without chemicals treatment from Territorial Inspectorat for Quality of Seeds and Implanting Material, Bihor. The germination ability was at *Triticosecale* var. Tristan 86% and Mungis 94%; *Triticum aestivum* L. var. Cubus 96% and Lukulus 92%. The oil of allyl isothiocyanate (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 at 30° C. Then, dilutions of 0.001%, 0.002% and 0.005% were performed, using the graduated cylinders and distilled water. The germination of cariopses was performed in sterile colorless plastic casseroles. The bottom of casseroles were covered with filter paper which was moisted with 35 ml of different dilution 0.001; 0.002 and 0.005% allyl isothiocyanate or distilled water (for control). For all experimental variants (V_1 – 0.001% ; V_2 – 0.002% ; V_3– 0.005%) and control lots 50 cariopses 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. Germination ability was determinate after 5 day. For seedling growth, after 5 day of germination, the embryonic and adventitious root length, coleoptiles and leaf height (cm) was determinate. Statistical analysis included: arithmetic media (M), standard deviation (sd) and Student's test (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 **Tristan variety triticale** was of 86% in the control plant. This value was changed in the experimental variants V_1- V_2- V_3 (84%, 88% and, respectively, 87%). The roots of the triticale seedlings are susceptible to the action of the allyl thiocyanate, their growth being significantly inhibited in 0.002% (V_2) and 0.005% (V_3) dilutions. The inhibition was statistically irrelevant only in the dilution of 0.001% (V1) active substance concentration. The increase of coleoptile and of the first leaflet is stimulated significantly in the experimental variant V_1, while in V_2 and V_3 stimulations are insignificant. The coleoptile and leaflets are not so sensitive to the action of allyl thiocyanate as the roots.

Table 1

Values of the procentual differences in raport with control (100%) and significance level (a-insignificant P>0.05; b-significant P<0.05; c-strongly significant P<0.001)

Cereals	Parameters	Dilution of the allyl isothiocyanate		
		V_1 – 0.001%	V_2 – 0.002%	V_3 – 0.005%
Triticosecale Witt. var. Tristan	Embryonic root length	-12.77a	-22.35b	-22.13b
	Adventitious root length	-10.56a	-15.61b	-14.45b
	Coleoptile height	+12.11b	+9.21a	+4.21a
	Leaf height	+13.90b	+7.10a	+2.61a
Triticosecale Witt. var. Mungis	Embryonic root length	-19.40b	-16.20b	
	Adventitious root length	-24.67c	-23.32c	
	Coleoptile height	-16.50b	-23b	
	Leaf height	-18.47b	-22b	
Triticum aestivum L.var. Cubus	Embryonic root length	-4.40a		
	Adventitious root length	-9.48b		
	Coleoptile height	-11.65a		
	Leaf height	-11.41a		
Triticum aestivum L.var. Lukulus	Embryonic root length	+35.95c	-22.70c	-59.50c
	Adventitious root length	+23.72c	-23.70c	-64c
	Coleoptile height	+44.68c	-25.38b	-68.49c
	Leaf height	+45.65c	-27.54b	-68.48c

The germination ability of **Mungis triticale variety** was of 94% in control caryopsis and of 94%, respectively 88% in the seeds germinated on filter paper moistened with 0.001% dilutions (V_1) and, respectively, 0.002% (V_2). The caryopisis did not germinate in the dilution of 0.005% (V_3). The roots of the seedlings were susceptible to the action of the allyl thiocyanate, their growth being significantly inhibited in 0.001% (V_1) and 0.002% (V_2) active substance concentration. Statistically significant inhibitions were recorded in V_1 –V_2 dilutions with regard to the average length increase of the coleoptile and of the first leaflet in the seedlings of Mungis triticale variety.

The germination of wheat caryopsis of **Cubus control variety** (GA = 96%) changed in the dilution of 0.001% allyl isothiocyanate (V_1) (GA = 98%). Total inhibition of the germination ability of caryopsis was recorded in the experimental variants V_2–V_3 under the action of bioactive, allelopathic substance. The adventitious and embryonic roots of wheat seedlings are sensitive to the action of 0.001% allyl isothiocyanate (V_1), their growth being insifnificantly inhibited in the case of the embryonic roots and significantly

inhibited in terms of adventitious roots. The growth of coleoptile and of the first leaflets has recorded statistically insignificant drawbacks.

The germination ability of the caryopsis of the control group of **Lukulus wheat variety** was of 92%, a value that was changed in the experimental variants V_1- V_2-V_3 (90%, 94% and 93%). The 0.001% dilution (V_1) of the active substance concentration significantly stimulated the roots; the growth of seedlings roots of Lukulus wheat variety was significantly inhibited in 0.002% and 0.005% dilutions of allyl isothiocyanate. In the experimental variant V_1, the growth of coleoptile and of the first leaflets is significantly stimulated from a statistical standpoint, while the inhibitions are significant in V_2 and V_3.

Many research work projects study the alelopatic effect of the watery extracts from different plants on the growth and development of other plants (cultivated plants or weeds)(Gul-e-Raana et al., 2012; Konstantinović et al., 2014; Saadaoui et al., 2014). Our first research work was concerned with the effect of the watery extracts from the horse radish 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). Consecquently, the numerous variances which interfere in the watery extract (Şipoş et al.,2012) are removed. The researches aim at using essential oils extracted from plants for their bioactive compounds (Cavalieri and Caporali, 2010; Mutlu et al., 2010; Jibiao et al., 2010). The main chemical component of black mustard essential oil is no less than 92% allylisothiocyanate (http://www.essentialoils.co.za/essential-oils).

The limit between the stimulating and inhibitory concentrations must be established with high accuracy for each species. Any mistake in concentration may lead to bioinhibition instead of biostimulation and vice versa. The research work has proved that a 0.002% juglona solution totaly inhibits the germination of the green salad seeds (Wegmann, 2007).

CONCLUSIONS

1. The germination ability of triticale and wheat caryopsis, in the experimental varieties that had germinated, was not significantly modified in comparison to the control plants.

2. The seedlings growth of **Tristan variety triticale** evolved in optimum conditions using the concentration of 0.001% allyl isothiocyanate. The root inhibition was statistically irrelevant while the growth of coleoptile and of the first leaflets was significantly stimulated.

3. In **Mungis triticale variety,** the growth of the seedlings was significantly inhibited in the concentrations of 0.001% and 0.002% allyl isothiocyanate.

4. **Cubus wheat variety** proved to be sensitive even to 0.001% dilution of allyl isothiocyanate. The growth of embryonic roots was insignificanty inhibited, while the grown of the adventitious roots was significantly inhibited. The growth of coleoptile and of the first leaflets recorded statistically insignificant drawbacks.

5. The 0.001% dilution of active substance concentration significantly stimulated the growth of the seedling roots of **Lukulus wheat variety**. Moreover, the growth of coleoptile and of the first leaflets was significantly stimulated from a statistical standpoint.

6. The boundary between the stimulatory and inhibitory concentrations for each species and variety should be precisely determined.

Acknowledgments:
Territorial Inspectorat for Quality of Seeds and Implanting Material, Bihor, for certified materials.

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