THE USE OF THE BIOCHEMICAL METABOLITES IN SUSTAINABLE AGRICULTURE SYSTEMS

Cristian BOSTAN, Adina HORABLAGA, Alina Lavinia CĂLUŞERU, Marius COMAN, Irina MARIAN, Adrian COJOCARIU, M. MEREU, Dorin GAITIN

University of Agricultural Sciences and Veterinary Medicine of Banat, Calea Aradului Street, no. 119, Timişoara, Romania
Corresponding author: bostancristian2000@yahoo.com

Abstract: *There is a global effort to eliminate the amount of the chemicals used in the production technology, by the introduction of biological and ecological substances. One of the possible solutions is the allelophaty, the use of a chemical interactions between plants. The substances with allelochemical potential are very diverse and are involved in many metabolic processes. These substances belong to different classes of secondary metabolites: phenols, terpenes, alkaloids and can be present in different plants organs.The aim of this paper is to establish an interface between the biochemical study and morphological study of the plants, emphasizing the structural and functional changes that the allelophatic biochemical interactions between plants can induce. The tolerance of Lolium perenne was assessed by the seedlings growing and by the externalization of the morphological characters, after the extracts application that contain pyrrolizidine alkaloids and ergot alkaloids obtained from the aerial part of Dactylis glomerata, Poa pratensis and Festuca rubra plants. The idea of the influence of some chemical substances eliminated in the environment by organisms on other neighboring organisms, was released when the results of some physiologists researchers led to the conclusion that the action of these metabolites is beneficial or not to the neighboring, receivers organisms. Based on the opinion that the plants from a vegetal community associate by the virtue of some " affinities" or "chemical tolerances," it was established an experience in which it was followed the extracts effect on the growth and development of Lolium perenne plants. The determination of the growing and development of the plants treated with extracts was made by biometrization and the applied extract doses were : 10ml/pot, 40ml/pot and 80ml/pot every 7 days. The biometric measurements were performed for the main sprout length, the number of leaves / sprout and the sprouts number. As regarding the influence of the extracts with alkaloids content on the growth and development of perennial ryegrass, the experience has shown that as the amount and the concentration of alkaloids increase, it affects in a negative way the growth and the development of Lolium perenne species.*

Key words**:** *perennial grasses, synthetic substances, ecological agriculture,extracts allelopathy*

INTRODUCTION

Allelophathy represents the effect of a plant to another plant by producing of chemicals compunds that are released in environment (MUT et al., 2010, FAGHIHI et al., 2011)

The lifetime of the allelophatic agents and pedoclimatic conditions are important factors in the starting, evolution and intensity of allelophatic phenomena in agroecosystems (EINHELLIG and LEATHER, 1988). Allelophathy emphasizes the idea of sustainability in agriculture, increasing food product quality, reducing environmental pollution and disease risks due to the use of various synthetic substances.

Based on the inventory of the genetic resources, it can be concluded that exist a quite large genetic variability for the selection and the creation of ecological solutions that have the potential to achieve performance in ecological agriculture system (INDERJIT, 2006, KHANH et al., 2007, EISENHAUER et al., 2009). In nature, plants are in multiple and complex

interrelations related to food security, defense, reproduction (JAMES et al., 2007). The interactions between species are part of the structural characteristc of the biocenosis (KOS. et al., 2008). Some plants release toxic substances that inhibit the growth of other plants, this feature gives them a competitive advantage (MUTLU et al., 2009).

Due to the complexity of the mechanisms by which the perennial grasses interact, in this study was approached the hypothesis of allelophatic properties at four species of grasses.

MATERIAL AND METHODS

The plants cultivation was conducted in vegetation pots under uniform conditions for all samples, the vegetation pots were kept in the growth chamber, under stable temperature and humidity (25 ° ± 2 ° C and 45%). The experiment was installed in three repetitions. Except the blank which was wetting with distilled water, the plants from the other pots were sprayed with weak alcoholic extracts obtained from the experimental plants. The extracts were applied in different doses: D1 = 10 ml / pot, D2 = 40 ml / pot, D3 = 80 ml / pot. In order to evaluate the effect of the allelopathic aqueous extracts, it were performed the following analyzes in relation to the blank groups: the main sprout length, the number of leaves / sprout and the number of sprouts / bush.

RESULTS AND DISCUSSIONS

Sprout length at *Lolium perenne* treated with *Festuca rubra* extract in version 1 is very significantly higher compared to the blank and distinct significantly higher when *Lolium perenne* was treated with *Poa pratensis* extract.

If the dose is increased at 40 ml / pot, the sprout length at *Lolium perenne* treated with *Festuca rubra* extract is the same as the first dose namely very significantly higher, the same signification can be found if the perennial ryegrass is treated with *Poa pratensis* extract.

Dactylis glomerata extract not influence in a positive way the sprout growth at *Lolium perenne*, whether applied the extract in version 1 or version 2.

If at lower doses, i.e. version 1 or version 2, has been an increase of *Lolium perenne* sprout length, when it is applied a higher dose i.e. version 3, the sprout length is influenced in a negative way because it is very significantly lower compared with the blank. (Table 1.)

Number of leaves per sprout is also influenced by the applied dose.

If in version 1 *Dactylis, Poa* and *Festuca* extracts not influence significantly the number of leaves at Lolium perenne, in version 2 when the amount of alkaloids increase, the number of leaves is distinctive significantly lower compared with the blank at *Lolium perenne* treated with *Dactylis glomerata* extract compared with *Lolium perenne* untreated and distinct significantly higher when is treated with the other two extracts.

In version 3, the number of leaves is significant or distinct significant lower than at plants treated with extracts compared to untreated plants (Table 1.).

Regarding the number of sprouts, *Lolium perenne* is positively influenced when it is sprayed with *Festuca rubra* and *Dactylis glomerata* extract in version 2, here the number of sprouts is very significantly higher than the blank.

As the amount of the extract increases, ie the version 3, the number of sprouts at *Lolium perenne* treated with three distinct extracts is significantly or very significantly lower than the blank. (Table 1.)

Table 1

The influence of the extracts on *Lolium perenne* morphological characters

	The shoot length (cm)			
Lolium perenne	$\bar{x} \pm sx$	$s\%$	u	Semnificatie
	Date – 19.09			
CONTROL	4.3±0.133	9.805		
Extract of D.g. – V1	4.5±0.166	11.712	0.937	-
Extract of F.r. – V1	5.7±0.169	9.429	6.480	XXX
Extract of P.p. – V1	4.74±0.129	8.624	2.369	XX
	Date – 12.10			
CONTROL	5.6±0.124	7.042		
Extract of D.g. – V2	3.8±0.081	6.794	-12.074	000
Extract of F.r. – V2	7.4±0.163	6.978	8.759	XXX
Extract of P.p. – V2	7.1±0.286	12.771	4.797	XXX
	Date – 14.11			
CONTROL	7.6±0.124	5.189		
Extract of D.g. – V3	5.34±0.231	13.710	-8.593	000
Extract of F.r. – V3	7.3±0.133	5.77	-1.643	-
Extract of P.p. – V3	5.8±0.2	10.904	-7.636	000
	DL 5%=2,26 (cm)	DL 1%=3,25 (cm)	DL 0,1%=4,78 (cm)	
	Leaves/shoot			
	Date – 19.09			
CONTROL	3.8±0.133	11.095		
Extract of D.g. – V1	3.4±0.163	15.188	-1.897	-
Extract of F.r. – V1	3.6±0.163	14.344	-0.948	-
Extract of P.p. – V1	3.4±0.163	15.188	-1.897	-
	Date – 12.10			
CONTROL	3.9±0.1	8.108		
Extract of D.g. – V2	3.4±0.163	15.188	-4.330	00
Extract of F.r. – V2	4.4±0.163	11.736	2.611	XX
Extract of P.p. – V2	4.4±0.163	11.736	2.611	XX
	Date – 14.11			
CONTROL	4.9±0.1	6.453		
Extract of D.g. – V3	4.4±0.163	11.736	-2.611	0
Extract of F.r. – V3	4.2±0.133	10.038	-4.2	00
Extract of P.p. – V3	4.3±0.152	11.233	-3.286	00
	DL 5%=2,26	DL 1%=3,25	DL 0,1%=4,78	
	Leaves/shoot			
	Date – 19.09			
CONTROL	1±0	0		-
Extract of D.g. – V1	1±0	0		-
Extract of F.r. – V1	1±0	0		-
Extract of P.p. – V1	1±0	0		-
	Date – 12.10			
CONTROL	0±0	0		
Extract of D.g. – V2	0±0	0	-	-
Extract of F.r. – V2	3.9±0.179	14.555	21.726	XXX
Extract of P.p. – V2	1.97±0.021	3.426	92.298	XXX
	Date – 14.11			
CONTROL	3±0	0		
Extract of D.g. – V3	1.3±0.152	37.157	-11.129	000
Extract of F.r. – V3	2.3±0.152	21.002	-4.582	00
Extract of P.p. – V3	2.3±0.152	21.002	-4.582	00
	DL 5%=2,26	DL 1%=3,25	DL 0,1%=4,78	

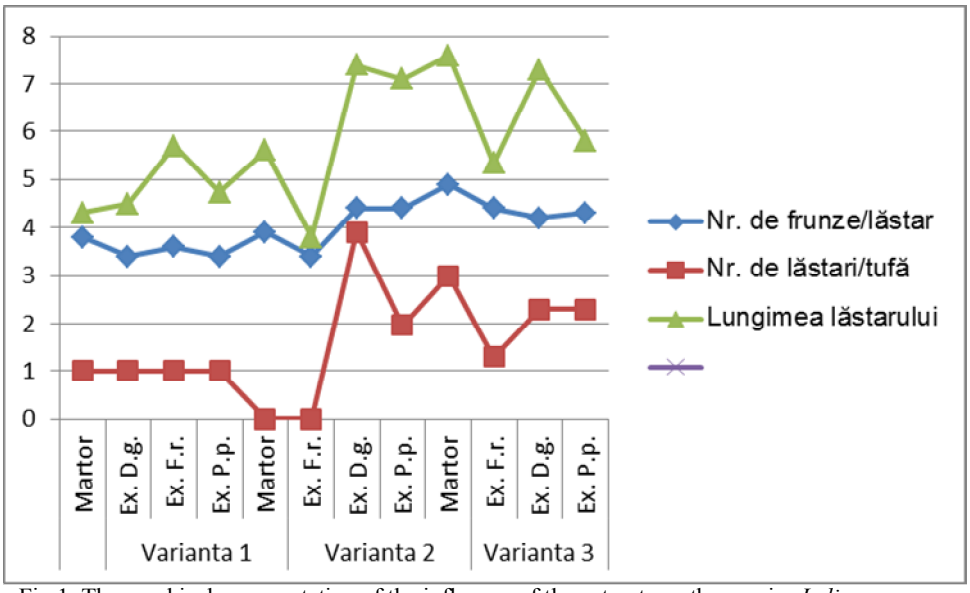

Fig.1. The graphical representation of the influence of the extracts on the species *Lolium perenne*

CONCLUSIONS

Phytotoxic effect of the extracts on Lolium perenne species manifests differently depending on the applied dose;

It can be observed a stimulation of the morphological characters at analyzed species (Lolium perenne) at lower doses of extracts (10 ml and 40 ml);

The extracts become active at higher concentrations, the maximum inhibitory effect can be observed at a dose of 80 ml, dose that inhibits the growth of plants treated with extracts;

Dactylis glomerata extract has inhibitory effect on the growth and development of Lolium perenne plants.

ACKNOWLEDGEMENTS

This work was financially supported by the project "POSTDOCTORAL SCHOOL OF AGRICULTURE AND VETERINARY MEDICINE", POSDRU/89/1.5/S/62371, co–financed by the European Social Fund through the Sectorial Operational Programme for the Human Resources Development 2007–2013.

BIBLIOGRAPHY

1. EINHELLIG, F.A., G.R., LEATHER, 1988 – Potential for exploiting allelopathy to enhance crop production. J. Chem. Ecol 14, 1829-1844.
2. EISENHAUER, N., SCHUY, M., BUTENSCHOEN, O., SCHEU, S., 2009 - Direct and indirect effects of endogeic earthworms on plant seeds. *Pedobiologia* 52: 151–162.
3. FAGHIHI, M.M., BAGHERI, A.N., BAHRAMI, H.R., HASANZADEH, H., REZAZADEH, R., SIAMPOUR, M., SAMAVI, S., SALEHI, M., IZADPANAH, K., 2011 - Witches'-Broom Disease of Lime Affects Seed Germination and Seedling Growth But Is Not Seed Transmissible. *Plant Disease* 95: 419–422.
4. INDERJIT, D., 2006 - Experimental complexities in evaluating the allelopathic activates in laboratory bioassay: A case study. *Soil Biology & Biochemistry* 38: 256–262.

5. JAMES, J.J., DRENOVSKY, R.E., 2007 - A basis for relative growth rate differences between native and invasive forbs. *Rangeland Ecology & Managemen* 60: 1–7.
6. KHANH, T.D., XUAN, T.D. CHUNG, I.M., 2007 - Rice allelopathy and the possibility for weed management. *Annals of Applied Biology* 151: 325–339.
7. KOS, M., POSCHLOD, P., 2008 - Correlates of inter-specific variation in germination response to water stress in a semi–arid savannah. *Basic and Applied Ecology* 9: 645–652.
8. MUT, Z., AKAY H., AYDIN, N., 2010 - Effects of seed size and drought stress on germination and seedling growth of some oat genotypes (*Avena sativa L.*). *African Journal of Agricultural Research* 5: 1101–1107.
9. MUTLU, S., OKKES, A., 2009 - Allelopathic effect of *Nepeta meyeri* Benth. extracts on seed germination and seedling growth of some crop plants. *Acta Physiologiae Plantarum* 31: 89–93.