THE INFLUENCE OF THE ALLELOPHATIC INTERACTIONS BETWEEN PLANTS

Cristian BOSTAN, Adina HORABLAGA, Alina Lavinia CĂLUŞERU, Cristian RUJAN, Adrian COJOCARIU, Marius COMAN, Andreea GHICA

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

Abstract: *This paper provides data regarding the mechanisms developed by plants (based on the biochemical interactions) in order to survive, and the use of these biochemical metabolites in sustainable agriculture systems. The research carried out highlights the effect given by loline alkaloids that were determined in low alcohol extracts of Lolium perenne, on the germination and the growing at the early development stages of the perennial grasses seedlings of Dactylis glomerata, Poa pratensis and Festuca rubra. The material plant used in bioassays consisted of roots, stems, leaves and inflorescence of Lolium perenneculese from the western part of Romania, the Banat region and seeds of Dactylis glomerata, Poa pratensis and Festuca rubra. In order to test the seed germination, the standard method was used. The growth of the embryonic rădăcinițelor and tulpinițelor was determined by biometrizare. The seed germination can be influenced by allelopathic compounds, the allelopathic inhibiting action of the seed germination is more frequent than the stimulation. The tested extracts that were applied in three different concentrations (alkaloids concentrations = 0.668% , dilution I = 0.334%, alkaloids concentrations and dilution II = 0.083%) because the biological activity of the allelophatic compounds is dependent on a characteristics concentration step. The studies on the seed germination ability under the influence of various extracts were made by several researchers which concluded that the direct effect of the allelophatic compounds can be a stimulating effect, but often it is an inhibitory effect. Many cultivated and spontaneous species produce allelochemical compounds that reduce the growth in the seedlings. This phenomenon is mainly due to direct interference with the cell division processes or with the growth hormones. Our studies have shown that allelophatic substances can inhibit the seed germination but can affect the growth and development of the plant receivers of these substances, so that allelophatic phenomenon is a cause-effect relationship between substances with allelophatic potential and physiological response of the target plant. The performed studies results show the following aspect: Lolium perenne extracts present inhibitory allelophatic activity on the seed germination and the application of the extracts doses in different concentrations shows that as the alleophatic substances concentration increase, the inhibitory effect increase; the growth of the plants maintained in an environment treated with extracts, is lower compared to the control sample and the effect is maximal at the highest concentration.*

Key words**:** *chemical componds, allelopathy, germination bioassays, growth bioassay*

INTRODUCTION

The existence of inhibition zones around perennial grasses, the diversity reduction of other plant species that compose Romanian meadows and also the changes in soil composition of these habitats, have suggested the involvement of the chemical compounds. This ability to dominate the habitat due to perennial grass species can be explained by the specific type of interrelations that these plants have developed between them and with other species.

Most times natural grasslands are now dominated by varieties of Festuca and Lolium. The feature of perennial grasses to exclude the growth of other plant species may be due to a

combination of factors or the production of toxic chemical compounds to other species (VANTU, 2003).

The similar chemical composition and the coexistence of different plants species can be strongly affected by the interactions between them (INDERJIT and CALLAWAY, 2003).

Also, whatever is the strategy of a plant species (conservation, competition, or aggressiveness), it is essential for any organism which develops in a certain environment. (LAMBERS et al. 1998).

The amensalisme represents the growth inhibition of the individuals of some species by the secretion products of another species (ARSENE, 2002). When this coactions occurs between plants, it is named allelopathy (PUIA et al, 1980).

The effect of some allelopathic substances on seeds germination capacity can be a stimulation one, but in most cases these substances inhibit the seeds germination. Similar studies have been made by several researchers such as OSVALD, 1949; C. H. MÜLLER, 1969; GHIRCĂ et al., 1974; J.M. BRADOW, 1989a; FISCHER, N.H., J.D. WEIDENHAMER şi PELLISSIER, F., 1993 b; THANG et al., 1995; BELZ R şi HURLE K., 2001; NARCISA BĂDEANU et al., 2002. Our research demonstrate the influence of Lolium perenne extracts with allelophatic potential on the germination capacity of seeds and on seedlings development of some perennial grasses.

MATERIAL AND METHODS

Preparation of aqueous extracts: 250g of vegetal material was fragmented into small pieces, of approximately 0.50 cm and was mixed with 500 mL distilled water for 30 minutes; the vegetal material thus obtained was left to stand, to macerate for 12 hours at room temperature, after which the supernatant was decanted, and the extract was filtered through paper filter and preserved until use in the dark at 4^0C. In these aqueous extracts, the obtained solution was considered as a reference aqueous extract, the obtained concentration being assessed as 100%.

Seed germination bioassays: after washed with deionized water, in each Petri dish a patch of filter paper was put with the same size as Petri dish bottom with 12 cm diameter, then it was sat 100 seeds in three repetitions. After the seeds placing, these were covered with a filter paper patch and it was added extract (liquid), respectively distilled water for the blank. The seeds reactions in the presence of the germination substrate of the aqueous extract were compared with the results obtained in the blank group, the seeds germinated in distilled water. The germination was reported – as the germination percentage - at 100 grains made germinated from each species.

Seedlings growth bioassay: it was determined the growth in length of the embryonic roots (radicles) and the hypocotyls by its biometrization. The biometric measurements regarding the average growth in length of the blank seedlings and their vegetative organs were considered as reference values, data at which were reported the biometric measurements performed in the treated groups with aqueous extracts.

Statistical analysis: the obtained data were interpreted statistically by the variance analysis. The significance of individual differences compared to the blank was calculated by limit difference method, represented by values: 0 - significantly, 00 - distinct significant and 000 - very significant.

RESULTS AND DISCUSSIONS

Lolium perenne extracts were applied in three different concentrations. The loline alkaloids content in the extracts was as follows:

- Version 1 - Concentrate = 0.668% alkaloids;
- Version 2 - Dilution I (obtained by dilution 1:1) = 0.334% alkaloids;
- Version 3 - Dilution II (obtained by dilution 1:2) = 0.083% alkaloids.

The seeds germination in blanks was 49% at the *Poa pratensis* species, 80% at *Dactylis glomerata* species and 37% *Festuca rubra*.

The application of some concentrated doses of extract (version 1) had a total inhibitory effect on the seeds germination of the tested perennial grasses.

In version 2, the inhibitory effect is not as pronounced. The seed germination of *Festuca rubra* is 1.33%, 5% for seeds of *Dactylis glomerata* and 10.33% for *Poa pratensis* species.

The highest percentage of germinated seeds at the three treated species was recorded in version 3. At version 3, the seeds of *Poa pratensis* germinated at a rate of 29%, those of *Dactylis glomerata* have a germination percentage of 23.33% and those of *Festuca rubra* of 7.67% (Table 1.)

Table 1

Germination percentage of seeds in control and Lolium extracts

	Control	**Concentration of extracts from *Lolium perenne***		
		(III)	**(II)**	**(I)**
Germination (%)	*Poa pratensis* 49% *Dactylis glomerata* 80% *Festuca rubra* 37%	*Poa pratensis* 29% *Dactylis glomerata* 23.33% *Festuca rubra* 7.67%	*Poa pratensis* 10.33% *Dactylis glomerata* 5% *Festuca rubra* 1.33%	*Poa pratensis* 0% *Dactylis glomerata* 0% *Festuca rubra* 0%

In order to highlight the effect given by *Lolium perenne* allelophatic extracts on the seedlings growth in the early stages of development, the measurement of the coleoptile and radicle was performed.

The coleoptile and radicle growth at *Poa pratensis* treated is influenced by the aqueous extracts containing alkaloids in all studied versions, the coleoptile and radicle being smaller compared to *Poa pratensis* blank. The statistic processing have shown a difference very significant smaller of the treated seedlings compared to the blank. (Table 2.; fig.1.).

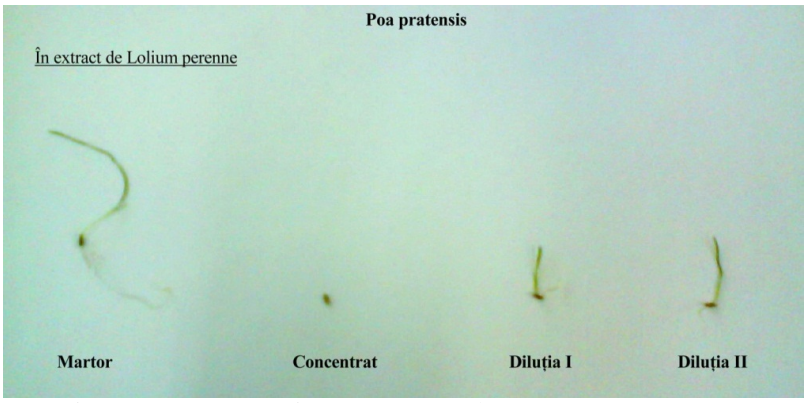

Fig.1. - 14 days *Poa pratensis L.* plants grown on *Lolium perenne L.* extract next to the untreated control

Table 1

The coleoptile and root length (cm) at *Poa pratensis L.*

Varianta	Control *Poa pratensis*			
	$\bar{x} \pm sx$	S%	u	Significance
Coleoptile	3.75 ± 0.083	7.027		
Radicle	5.5 ± 0.166	9.582		
Poa pratensis* in *Lolium perenne extract				
Coleoptile				
V1	0 ± 0	-	-45	000
V2	1.01 ± 0.106	33.478	-20.211	000
V3	1.40. ± 0.016	3.536	-26967.	000
Radicle				
V1	0 ± 0	-	-33	000
V2	0.5 ± 0	0	-30	000
V3	1.6 ± 0.033	6.588	-22.945	000
	DL5%=2,26(cm)	DL1%=3,25(cm)	DL0,1%=4,78(cm)	

The effect *Lolium perenne* extracts was also observed at *Dactylis glomerata* species. Compared with untreated blank, the morphological characters (radicle, coleoptile) are deeply affected. The statistical analysis have shown, also in this case, a difference significantly smaller at the treated seedlings compared to the blank. (Table 3.; Fig.2.)

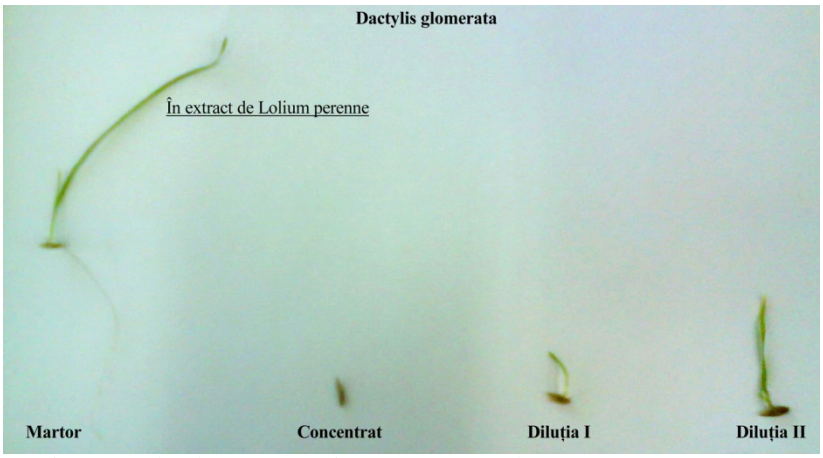

Fig.2. - 14 days *Dactylis glomeratas L.* plants grown on *Lolium perenne L.* extract next to the untreated control

Table 3

The coleoptile and root length (cm) at *Dactylis glomerata L.*

Varianta	Control *Dactylis glomerata* $\bar{x} \pm sx$	$s\%$	u	Significance
Coleoptile	5.5±0.129	7.422		
Radicle	7.75±0.083	3.400		
Dactylis glomerata* in *Lolium perenne extract				
Coleoptil				
V1	0±0	-	-42.602	000
V2	1.5±0.033	7.027	-30	000
V3	2.44±0.030	3.959	-23.065	000
Radicle				
V1	0±0	-	-93	000
V2	0.2±1.57	2.48	-90.6	000
V3	0.57±0.044	24.879	-75.871	000
	DL 5%=2,26 (cm)	DL 1%=3,25 (cm)	DL 0,1%=4,78 (cm)	

The data presented in Table 4 show the same aspect as in the previous cases. Also, for *Festuca rubra* species the alkaloid content of *Lolium perenne* influence in a negative way the growth and the development of *Festuca rubra* seedlings.

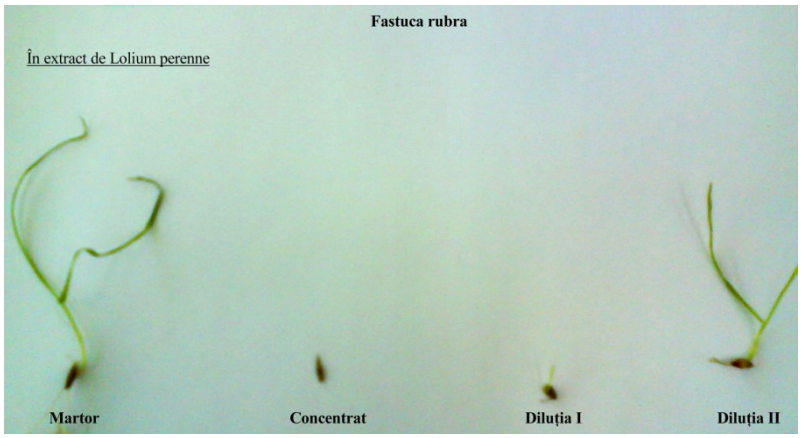

Fig. 3. - 14 days *Festuca rubra L.* plants grown on *Lolium perenne L.* extract next to the untreated control

Table 3

The coleoptile and root length (cm) at *Festuca rubra L.*

Varianta	Control *Festuca rubra* $\bar{x} \pm sx$	$s\%$	u	Significance
Coleoptile	7.01±0.125	5.644		
Radicle	8.63±0.112	4.125		
	DL 5%=2,26 (cm)	DL 1%=3,25 (cm)	DL 0,1%=4,78 (cm)	
Festuca rubra* in *Lolium perenne extract				
Coleoptile				
V1	0±0	-	-56.025	000

V2	0.56±0.016	9.221	-51.116	000
V3	4.88±0.184	11.940	-9.562	000
Radicle				
V1	0±0	-	-76.646	000
V2	0.2±1.57	2.48	-74.869	000
V3	0.67±0.047	22.304	-65.186	000
	DL 5%=2,26 (cm)	DL 1%=3,25 (cm)	DL 0,1%=4,78 (cm)	

CONCLUSIONS

Lolium perenne extracts negatively affect the seeds germination of *Poa pratensis*, *Dactylis glomerata* and *Festuca rubra*.

The inhibition of the seeds germination was determined by the concentration of the alkaloids present in the extract, a total inhibition was observed in the extract with a higher concentration.

As the content of the allelochemical compounds from the extracts increased, the increase in length of seedlings was inhibited.

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