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A STUDY ON THE ALLELOPATHIC POTENTIAL OF *Convolvulus arvensis* LEAVES AND ROOTS

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Abstract. Many annual and perennial weed species have been proved to possess a definite allelopathic potential. They are able to affect significantly growth, development and productivity of agricultural crops. The aim of the present study was to establish the allelopathic effect of physiologically active substances, released by a *Convolvulus arvensis* donor on the acceptor. A series of laboratory and greenhouse experiments were conducted by assessing a number of physiological and biometric parameters and determining the organic content. Concentrations of *Convolvulus arvensis* extracts with stimulating and inhibiting effect on tomatoes were established.

Keywords: allelopathy, inhibition, environment, biological agriculture, climatic factors, agrometeorological conditions.

AIMS AND BACKGROUND

Allelopathy plays an important ecological role. The studies conducted during the last decades determined this natural phenomenon as an alternative to pesticides for protecting soil free of weeds and soil pests, which is a necessary condition for producing ecologically sound production.

The investigations in the field of biochemical interrelations were presented by Muller[1], Grumer[2], Reis[3], etc. According to Waller[4], allelopathy is a process including biomolecules, formed by plants, algae, bacteria, fungi, and viruses which affect the growth and development of phytocenoses in agro- and natural ecosystems. This definition was adapted and accepted by the International Allelopathy Association in 1994.

Allelochemicals, synthesised by and inhibiting higher plants belong to the group of collins. They are released in the environment through water washing by sprinkling or rains, from roots into the soil or as volatile substances at transpiration.

The allelochemicals released from the rhizomes of perennial weed species into the soil can inhibit germination, growth and development of agricultural

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crops. The amount of allelochemicals synthesised and released into the soil depends to a great extent on the environmental ecological factors.

The objective of the present study was to establish the effect of allelochemicals, extracted and released in a natural way from the rhizome-propagated weed *Convolvulus arvensis*, on the germinability of tomato seeds.

EXPERIMENTAL

A series of laboratory and greenhouse experiments were carried in the Department of Agroecology to estimate the allelopathic effect of *Convolvulus arvensis* on the germinability of seeds from tomato cv. Amati. The greenhouse experiment was conducted in a plastic 40 m^2 greenhouse. The course of the main meteorological elements was monitored and the corresponding irrigation was applied.

Tomatoes were transplanted on 8 April 2001 in three rows at interrow spacing of 80 cm. The agrometeorological conditions at the time of transplanting were preceded by a relatively warm and dry weather during the early spring period, typical for the Plovdiv region in the last years[5]. The relatively below-normal precipitations in February and March with relatively higher air temperatures, contributing to lower soil water reserves in early spring, which together with the decreased relative air humidity on the first days after transplanting, were compensated for by the number of irrigations applied. After conducting the necessary agrotechnical practices (hoeing and irrigation), an additional extract from *Convolvulus arvensis* roots, obtained through a standard methodology, was applied at different concentrations (5%, 10%). The experiment was carried out in two variants – fertilized (NPK) and unfertilized. The main physiological and biometric parameters were monitored and a chemical analysis of fruits was made. The agrometeorological conditions during vegetation were also analysed by comparing them with the temperature values necessary for tomato development[6].

RESULTS AND DISCUSSION

The results obtained showed a slight inhibition of the parameters tested in comparison with the control, which increased proportionally with the increase of the concentrations used.

The results for the main physiological traits in the tested variants are given in Table 1.

Table 1. Measurement of leaf gas exchange in tomato plants grown under greenhouse conditions

	A	*P*	*S*	*T*
1	2	3	4	5
Variant		Unfertilized		
Control	2	1.67	0.05	16.50
	3	1.70	0.06	15.60
	4	1.70	0.06	15.60
	5	1.38	0.04	15.82
	6	1.61	0.05	16.65
	11	1.37	0.03	16.40
	12	1.76	0.05	16.28
	mean	1.60	0.048	16.12
5%	7	1.19	0.03	15.29
	8	1.48	0.04	15.05
	9	1.10	0.03	12.63
	10	1.45	0.04	12.01
	13	1.99	0.06	18.32
	14	2.10	0.06	16.67
	mean	1.55	0.043	14.99
10%	15	1.06	0.02	14.47
	16	1.64	0.04	15.42
	17	1.00	0.02	13.91
	18	1.61	0.04	16.75
	19	1.92	0.05	15.88
	20	1.53	0.04	18.34
	21	1.92	0.05	18.87
	mean	1.52	0.037	16.23
Variant		Fertilized		
Control	34	0.69	0.02	18.01
	35	1.49	0.04	16.58
	36	0.92	0.02	17.46
	37	1.50	0.04	17.22
	38	1.43	0.03	13.63
	39	1.85	0.04	14.62
	41	1.49	0.03	18.36
	42	1.48	0.03	18.20
	mean	1.35	0.031	14.88
5%	22	1.31	0.03	17.06
	23	1.62	0.04	16.25
	24	1.04	0.03	20.22
	25	1.56	0.04	19.31
	26	1.78	0.05	18.05
	27	1.13	0.03	15.03
	43	1.65	0.04	18.25
	44	2.10	0.05	18.52
	mean	1.52	0.038	17.83

to be continued

Continuation of Table 1

1	2	3	4	5
10%	28	1.35	0.03	16.72
	29	1.34	0.03	16.54
	30	1.06	0.02	13.46
	31	1.96	0.05	19.93
	32	1.28	0.03	15.57
	33	1.75	0.04	15.11
	45	1.21	0.03	17.90
	46	1.19	0.03	17.54
	mean	1.39	0.032	16.52

Date – 06.06.2001; time – 11-12h; lighting – 1300 μmol $m^{-2} s^{-1}$; temperature – 25°C; the measurements were made on the last fully developed leaves from top down; *A* – record No; *P* – transpiration rate, μmol H_2O $m^{-2} s^{-1}$; *T* – photosynthetic rate, μmol CO_2 $m^{-2} s^{-1}$

The analysis of organic substances and the vitamin C content in fruits, expressed in percent to their fresh weight, showed a tendency to increase of the tested parameters when a 5% concentration of *Convolvulus arvensis* extract was used. The results obtained confirmed the literature data about the stimulating effect of allelochemicals, when applied at low concentrations[7].

Table 2 shows the mean values of the parameters tested.

Table 2. Analysis of organic substances and vitamin C content in fruits of tomato cv. Amati (% to fresh weight)

Variants	Dry matter (%)	Vitamin C (%)	Sugars (glucose) (%)	Total acidity (%)
Control – unfertilized	4.77	15.16	2.76	0.36
Control– fertilized	4.72	14.42	2.55	0.39
5% (unfertilized)	4.91	15.36	2.89	0.38
5% (fertilized)	4.99	15.64	2.78	0.38
10% (unfertilized)	4.80	19.29	3.00	0.37
10% (fertilized)	4.77	15.92	3.10	0.38

The same tendency was established in the biometric parameters, too, which is given in Table 3.

Table 3. Biometric measurements in tomato cv. Amati during vegetation

Variants	Inflorescence number	Fruit number	Plant height (cm)	Inflorescence initiation
Control – unfertilized	4	11	106.6	at 3-leaf intervals
Control– fertilized	3	11	109.0	at 3-leaf intervals
5% (unfertilized)	3	12	109.4	at 3-leaf intervals
5% (fertilized)	4	12	111.8	at 4-leaf intervals
10% (unfertilized)	3	14	114.6	at 3-leaf intervals
10% (fertilized)	4	11	115.6	at 3-leaf intervals

CONCLUSIONS

1. The allelochemicals from the weed species *Convolvulus arvensis* affected the main physiological, morphological and biometric parameters of tomato plants and fruits. When applied at low concentrations, they showed a tendency to stimulation which decreased and changed to inhibition with the increase of their concentrations.

2. The allelochemicals, containing *Convulvulus arvensis* extract, affected germinability of tomato seeds. Their 10% concentrations, applied in both variants (unfertilized and fertilized) had inhibiting effect, while the rest of the concentrations showed no significant differences from the control.

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