



Allelopathic potential of weeds under the minimalization of soil treatment

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Abstract

The content of water-dispersible phenol substances in rhizosphere both of annual and perennial species of weeds (*Cirsium arvense*, *Sonchus arvensis*) increases under soil treatment minimalization. The higher content of phenol substances of researched weeds is defined in rhizosphere of Common Couch (*Agropyrum repens*). The absence of intensive anthropogenic treatment of plowing layer which accumulates the significant mass of weed's roots in the cause of much more higher allelopathic potential of some species' of weeds. The high level of saturation by weeds in agrophytocoenosis under non-tillage soil treatment is defines the competitiveness between certain sepsis' of weeds, especially, at the beginning of the vegetation. In this case, increasing the secretion of phenol substances is one of the physiological screenings of such competitiveness.

Keywords: Allelopathic potential, phenol substances, phytotoxicity, soil treatment minimalization, rhizosphere, weeds.

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Introduction

The absence of intensive anthropogenic treatment to the plowing layer which accumulates the significant mass of weed's roots is the cause of high allelopathic potential of some weed's species. The group of water-dispersible substances with the high level of liability has a great of importance in allelopathic interactions into agrophytocoenosis (Gorobets and Nazarenko, 1982). The hypothesis tested was that the high level of saturation by weeds in agrophytocoenosis, as a result of non-tillage soil treatment, defines the competitiveness between certain weed's species, especially, at the beginning of the vegetation. The increasing of the secretion of phenol substances is one of the physiological screenings of such competitiveness (Grodzinsky, 1965, 1982; Zakharenko, 1997). Researches of the influence of phenol substances secreted by weeds on growth of spring cereals are carried out.

At the beginning of the vegetation under the minimum tillage the content of water-dispersible phenol substances increases both in rhizosphere of annual (*Galeopsis speciosa* Mill. (Hemp-nettle), *Matricaria inodora* L. (Scentless Mayweed) and perennial weed's species (of *Cirsium arvense* (L.) Scop. (Creeping Thistle), *Sonchus arvensis* L. (Perennial Sowthistle) weed's species. The higher content of phenol substances is defined in rhizosphere of *Agropyrum repens* (L.) P.B. (Common Couch).

Material and Methods

Testing of soil phytotoxicity was done by the sprouting of barley's seeds into the water extract from rhizosphere soil of different weed's species under ploughing and non-tillage soil treatment. Rhizosphere soil

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was flooded by the water in correlation 1:1 and infused during 24 hours, after that the soil solution was filtered. Barley's seeds were laid out evenly on the strip of the filter paper 20 cm by width which was wet in advance by the soil extract of definite weeds. After that the strip was rolled friable and put into the glass filled by soil extract, after that the glasses were put for seeds' sprouting in thermostat. The sufficient temperature was being kept in thermostat - $20-30\pm 2^{\circ}\text{C}$. The count of sprouted seeds was done in accordance with the defined rules (the days of seed's laying out and the count of germs were considered as one twenty-four-hour period). The height of germs and the length of roots were defined as well.

Results

It was defined, that the highest content of phenol substances under non-tillage soil treatment is in rhizosphere of *Agropyrum repens* (L.) P.B. (Common Couch). During the vegetation period under non-tillage soil treatment the content of phenol substances in rhizosphere of *A. repens* exceeded that index in rhizosphere of *Cirsium arvense* (L.) Scop. (Creeping Thistle) in average in 2.25 times, in rhizosphere of *Sonchus arvensis* L. (Perennial Sowthistle) - in 1.5 times. During the vegetation period the content of phenol substances in rhizosphere of *A. repens* exceeded in average that index for all other weed's species in 2.1 times. During research period under non-tillage soil treatment the contents of phenol substances in rhizosphere of *Galeopsis speciosa* Mill. (Hemp-nettle), *Matricaria inodora* L. (Scentless Mayweed) and *S. arvensis* were equal and the difference between them into the limit of least significant difference ($\text{LSD}_{P<0.05}$). During the vegetation period under ploughing the content of phenol substances in rhizosphere of *G. speciosa* was considerably lower in comparison with *C. arvense* (3.31 mg kg^{-1} and 5.16 mg kg^{-1} accordingly for $\text{LSD}_{0.05} = 1.76 \text{ mg kg}^{-1}$) (Table 1).

Table 1. Content of phenol substances (protocatechuic acid, mg) in rhizosphere soil (1 kg) of different weed's species

Weed's species	Oat			Barley		
	At the beginning of vegetation	At the end of vegetation	In average for 02 dates of count	At the beginning of vegetation	At the end of vegetation	In average for 02 dates of count
Ploughing						
<i>G. speciosa</i> Mill.	2,60	2,03	2,32	3,45	3,17	3,31
<i>M. inodora</i> L.	3,19	2,92	3,06	4,73	4,58	4,66
<i>C. arvense</i> L.	2,95	2,77	2,86	5,36	4,95	5,16
<i>S. arvensis</i> L.	3,12	2,53	2,83	5,00	4,54	4,77
Non-tillage soil treatment						
<i>G. speciosa</i> Mill.	3,72	2,14	2,93	3,88	3,36	3,62
<i>M. inodora</i> L.	3,64	3,36	3,50	4,58	3,92	4,25
<i>C. arvense</i> L.	4,07	3,58	3,83	5,55	4,27	4,91
<i>S. arvensis</i> L.	6,22	4,68	5,45	6,57	5,05	5,81
<i>A. repens</i> (L.) P.B.	9,15	8,05	8,60	11,12	8,52	9,82
$\text{LSD}_{0.05}$			1,21			1,76

The content of water-dispersible phenol substances in rhizosphere both of annual and perennial weed's species (*C. arvense*, *S. arvensis*) increases under the minimum tillage. The higher content of phenol substances among all tested weeds is defined in rhizosphere of *A. repens*. Researching of the influence of water extract from weed's rhizosphere under ploughing on the seed's germination of the test-crop (barley (*Avena sativa* L.) screened that rhizospheres of *C. arvense* and *M. inodora* have the most phytotoxic effect. The water - dispersible substances in rhizospheres of *C. arvense*, *S. arvensis*, *M. inodora* and *G. speciosa* produce considerable phytotoxic effect both under ploughing and non-tillage soil treatment. The number of sprouted seeds of barley was decreased in 14% in the result of the influence under ploughing of water - dispersible substances in rhizosphere of *M. inodora*. The rhizospheres of *A. repens*, *C. arvense* and *S. arvensis* screened the high phytotoxic effect under non-tillage soil treatment. Rhizosphere of *G. speciosa* has the less phytotoxicity in comparison with the other weed's species.

The indexes of the number of sprouted seeds, the height of germens and the length of roots of test-crop under the reduction of soil treatment depend on the phytotoxicity of weed's rhizospheres (Table 2).

Table 2. The influence of water-dispersible substances of weed's rhizospheres on the germination of barley seeds under the different soil treatments (in average)

Variant	The number of sprouted seeds		The height of germens		The length of roots,mm	
	mm	%	mm	%	mm	%
Control *	81	100	8,3	100	59,6	100
	78	100	8,1	100	57,0	100
<i>C. arvensis</i> L.	73	90	6,4	77	50,0	84
	62	79	6,3	78	48,8	86
<i>S. arvensis</i> L.	70	86	6,7	81	52,1	87
	60	77	6,6	81	49,1	86
<i>A. repens</i> (L.) P.B.	–	–	–	–	–	–
	51	65	5,3	65	42,8	75
<i>G. speciosa</i> Mill.	72	89	7,5	90	54,1	91
	65	83	6,7	83	50,3	88
<i>M. inodora</i> L.	70	86	6,9	83	51,9	87
	58	74	6,1	75	47,5	83
LSD _{0.05}	4,13	–	0,42	–	2,70	–

* control - water soil extract;

- numerator - ploughing;

- denominator - non-tillage soil treatment

Discussion

The intensive allelopathic effect upon plants, especially, at the beginning of the vegetation is the cause of the considerable increasing of the harmfulness of weed's populations under the minimum tillage. But, the earlier germination and intensive growth of weeds in the period from the sprouting till the implementation of means for plant protection provide the weeds by significant advantages in the competitive interactions into agrophytocoenosis. The level of the influence by the certain weed's species on the plants is significantly defined by the weed allelopathic efficiency. The control of weed allelopathic efficiency could be the important reserve for the formation of high-productive agrophytocoenosis.

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