more massive palisade mesophyll tissue performing a principal part in photosynthesis. The cumulative effect of both treatments manifested itself in a considerable development of mechanical stem tissue and consequent increasing the plant resistance to lying flat.

Key words: Glycine max, Bradyrhizobium japonicum, retardants, anatomic structure

Рекомендує до друку Надійшла 5.07.2012
Н.М. Дробик

УДК 581.524.13+547.5+582.998.16

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THE INVESTIGATION OF *PYRETHRUM COCCINEUM* (WILLD.) WOROSCH. ALLELOPATHIC ACTIVITY

The dynamics of allelopathic activity of water- and alcohol-soluble extracts and the content of phenolic substances in the *Pyrethrum coccineum* (Willd.) Worosch. vegetative and generative organs was investigated. Leaves and flowers are found to accumulate the greatest number of phenolic compounds in the flowering stage. Inverse correlations were found between the number of phenolic compounds and allelopathic activity of the exudates.

Key words: Pyrethrum coccineum *(Willd.) Worosch., allelopathic activity, phenolic substances*

A complex of various factors, including the allelopathic interactions between plants, plants and soil microflora is the basis of the formation and existence of plant communities [3, 10]. The allelopathic activity and tolerance of plant species provide vital activity of organisms in biogeocoenose. Using the principles of allelopathic relationships in crop allows to create mixed and compacted plant crops that have a broader adaptive potential. The aromatic plants, which display multifunctional properties and can be used in different sectors of the economy, are the important components of mixed crops [8].The species of the genus *Pyrethrum* Zinn. are prospective aromatic, air-oil, medicinal and insecticidal crops [7].

The aim of this work is to find out the dynamics of allelopathic activity of water- and alcohol-extracts as well as quantitative content of phenolic compounds in the *Pyrethrum coccineum* (Willd.) Worosch. vegetative and generative organs.

Materials and Methods

The vegetative and generative organs of *P. coccineum* served as the object of the research. Field experiments were laid in the Western Forest-steppe zone on gray forest sandy loam soils of research plots of Kremenets regional humanitarian-pedagogical institute named after Taras Shevchenko. The study was conducted with plants of the second year of vegetation.

Allelopathic activity was determined using A. M. Grodzinsky's method [2]. Hoods which were prepared by the infusion of crushed plant material in distilled water and 70% ethanol during a day at a temperature of 24-25 °C served as model plant exudates. The relation between plant material and weight of solvent's volume was 1:10, 1:50. Soft wheat (*Triticum aestivum* L.) and cress (*Lupidium sativum* L.) were used as biotests. Seedlings grown in distilled water served as control.

The amount of phenolic compounds was determined by the method based on their oxidation by Folin-Chokalto reagent [1]. Statistic processing of the research results was conducted with M. E. Kucherenko and others [5].

Results and Discussion

It has been found that water-soluble exudates of *P. coccineum* vegetative and generative organs contained minor amounts of phytotoxynes and at 1:10 breeding they showed inhibitory effect on the growth of roots and an indifferent effect on the coleoptiles of soft wheat (Fig. 1. A, B). Leaves accumulated the largest number of inhibitors during plant ontogenesis. Their inhibition percentage was 33,8 (budding) and 70,5 (fruiting). The allelopathic active substances of stems showed an inhibitory effect during plant flowering and fruiting, and extracts from the roots did not alter the growth processes of seedling bioassays significantly.

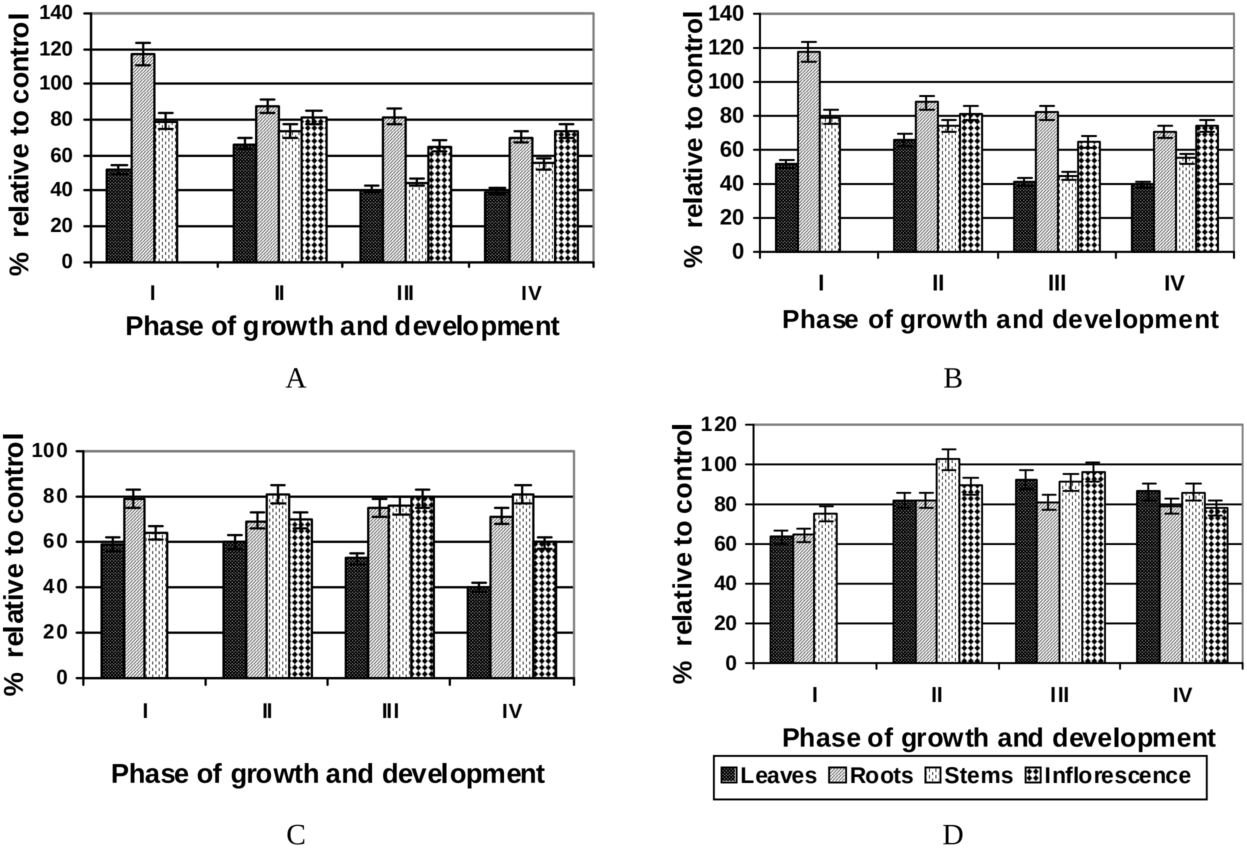

Figure. 1. Allelopathic activity of water-soluble (A, B) and alcohol-soluble exudates (C, D) of vegetative and generative organs in *P. coccineum* ontogenesis; (Biotest: A, B – soft wheat roots, B, C – soft wheat coleoptiles, breeding 1:10) 1 – the beginning of vegetation, II – budding, III – flowering, IV – fruiting

A number of alcohol-soluble fitotoxins in plants leaves increased during their ontogeny (Fig. 1. C.). The percentage of growth processes inhibition of test culture was 41,1 (at the beginning of vegetation) – 70,3 (fruiting) (biotest is the wheat roots). The stems extracts reduced the root growth bioassays by 41,1% only at the beginning of the plants growing season. It is worth being noted that the water-soluble persistent allocation of vegetative organs showed inhibitory effect on the growth of wheat coleoptiles during the plant flowering, alcohol-extracts made an effect on them at the beginning of vegetative (Fig. 1. B, D).

The inflorescence accumulated the most phytotoxins in the flowering and fruiting phases. As the content of inhibitors in extracts was decreased (breeding 1:50) an indifferent effect of water- and alcohol-soluble exudations on growth processes bioassays was observed.

The cress roots showed a higher sensitivity to the action of allelopathic active *P. coccineum* compounds. The exudation of vegetative and generative organs showed strong inhibitory effect on seedling growth bioassays at maximum concentration (breeding 1:10). The content of fitotoxins in aerial parts increased during ontogenesis and reached maximum values at plant flowering and fruiting time (Table 1.).

Table 1

Allelopathic activity of water-soluble exudates of vegetative and generative organs in *P. coccineum* ontogenesis (biotest – cress roots)

Organ	Phase of the growth and development							
	The beginning of vegetation		Budding		Flowering		Fruiting	
	M±m	%	M±m	%	M±m	%	M±m	%
Breeding 1:10								
Leaves	13,0±0,2	60,4	10,4±0,5	48,8	9,1±0,3	42,3	5,8±0,2	26,9
Roots	12,8±0,2	59,7	16,1±0,3	74,7	14,8±0,5	68,8	15,5±0,3	72,1
Stems	16,1±0,6	75,0	11,5±0,3	53,3	10,4±0,4	48,2	9,5±0,3	44,4
Inflorescence	–	–	16,0±0,4	74,4	11,1±0,2	51,4	10,3±0,2	48,1
Breeding 1:50								
Leaves	17,5±0,3	81,6	18,6±0,3	86,4	14,1±0,3	65,4	16,9±0,2	78,5
Roots	17,5±1,4	81,5	18,0±0,2	83,6	18,9±0,3	87,9	17,2±0,4	79,8
Stems	19,6±1,3	91,3	18,4±0,7	85,7	16,8±0,4	78,3	16,2±0,3	75,2
Inflorescence	–	–	18,6±0,3	86,7	13,4±0,2	62,5	15,0±0,2	69,9

The percentage of growth processes inhibition of cress-salad ranged from 48,6 – 51,3 (inflorescences) to 57,7 – 73,1 (leaves), respectively. Roots accumulated the largest amount of allelopathic active compounds at the beginning of vegetation.

The alcohol-soluble exudates of leaves contained the greatest number of fitotoxins during the ontogeny and inflorescence during plant flowering and fruiting. At a maximum concentration (breeding 1:10) the number of inhibitors were 34,5 (fruiting) – 54,6% (budding) and 49,1 – 49,7%, respectively. The contents of allelopathic active compounds in the stems and roots were slightly lower (Table 2.).

Table 2

Allelopathic activity of alcohol-soluble exudates of vegetative and generative organs in *P. coccineum* ontogenesis (biotest – cress roots)

Organ	Phase of the growth and development							
	The beginning of vegetation		Budding		Flowering		Fruiting	
	M±m	%	M±m	%	M±m	%	M±m	%
Breeding 1:10								
Leaves	9,5±0,1	45,4	12,3±0,2	58,4	11,8±0,4	56,2	13,8±0,1	65,5
Roots	16,4±0,1	78,0	15,1±0,4	72,1	16,1±0,2	76,8	16,4±0,2	78,2
Stems	13,2±0,5	62,8	15,7±0,3	74,8	12,7±0,3	60,4	14,5±0,2	69,1
Inflorescence	–	–	16,2±0,5	77,2	10,7±0,4	50,9	10,3±0,1	50,3
Breeding 1:50								
Leaves	14,8±0,8	70,6	19,1±0,7	91,1	15,1±0,5	71,9	16,5±0,1	78,7
Roots	18,0±0,1	85,7	15,2±0,2	72,6	17,4±0,3	82,7	18,9±0,1	90,2
Stems	16,8±0,4	79,9	18,0±0,3	85,8	15,4±0,2	73,1	18,2±0,1	86,6
Inflorescence	–	–	17,3±0,3	82,2	14,1±0,2	67,3	15,1±0,3	72,0

At 1:50 breeding a decreasing inhibitory influence of allelopathic active compounds of *P. coccineum* was seen. The highest number of phytotoxins was contained by water soluble exudates inflorescences and leaves at plants flowering and fruiting. The length of cress roots was 62,5 – 69,9 and 65,4 – 78,5% compared with seedlings grown in distilled water, respectively. The alcohol soluble exudates of leaves showed a significant inhibitory effect at the beginning of vegetation and inflorescences made an effect on them during flowering. The contents of inhibitors were 29,4 and 32,7%, respectively.

The allelopathic activity of plants was caused by the synthesis and release into the environment of a variety of biologically active compounds, among which a phenolic substances occupy an important place [4, 9, 11]. It has been established that the contents of phenolic compounds in plant organs during ontogenesis have increased and reached a maximum at the flowering stage, and slightly decreased during plants fruiting stage (Table 3). A number of phenolic substances in leaves and inflorescences were the highest one.

Table 3

Quantitative content of phenolic substances in *P. coccineum* vegetative and generative organs, mkg / 100 g of dry matter

Organ	Phase of the growth and development			
	The beginning of vegetation	Budding	Flowering	Fruiting
Leaves	917,5 ± 21,1	1374,0 ± 42,9	2163,0 ± 135,5	2130,4 ± 32,2
Roots	361,9 ± 11,6	640,3 ± 13,9	790,9 ± 8,2	723,2 ± 8,8
Stems	424,7 ± 14,9	512,0 ± 14,6	877,4 ± 27,8	592,4 ± 5,2
Inflorescence	–	846,3 ± 24,3	2080,0 ± 42,5	1519,1 ± 8,8

The content of phenolic substances in the vegetative and generative organs and bioassays growth processes under the influence of *P. coccineum* allelopathic active compounds correlated inversely. The presence of stable relationships between the content of phenolic substances and the inhibition percentage of soft wheat and cress roots growth was found (r = -0,60 and -0,67 for water and -0,61 and -0,58 for water-ethanol exudates, respectively). So allelopathic activity of *P. coccineum* caused, to a large extent, the presence of phenolic compounds.

Conclusions

The allelopathic activity of water soluble and alcohol soluble *P. coccineum* exudates depends on the topography of the organs investigated, extracts concentrations and bioassays sensitivity. Leaves accumulated the highest content of inhibitors during the ontogenesis and inflorescence during plant flowering and fruiting.

A number of phenolic substances in *P. coccineum* organs increased during the plant ontogenesis. The highest content is found in the leaves and inflorescences during plant flowering, which is caused by apparently high metabolic activity of these organs. Inverse correlations were found between the content of phenolic compounds and allelopathic activity of the exudates.

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АЛЕЛОПАТИЧНА АКТИВНІСТЬ *PYRETHRUM COCCINEUM* (WILLD.) WOROSCH.

Досліджено динаміку алелопатичної активності водо- і спирторозчинних екстрактів та вмісту фенольних сполук у вегетативних і генеративних органах піретруму червоного (*Pyrethrum coccineum* (Willd.) Worosch). Встановлено, що найбільшу кількість фенольних сполук накопичували листки та суцвіття у фазі цвітіння. Виявлено наявність зворотних кореляційних зв'язків між кількістю фенольних сполук та відсотком інгібування ростових процесів біотестів.

Ключові слова: Pyrethrum coccineum *(Willd.) Worosch., фенольні сполуки, алелопатична активність*

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АЛЕЛОПАТИЧЕСКАЯ АКТИВНОСТЬ *PYRETHRUM COCCINEUM* (WILLD**.)** WOROSCH**.**

Исследована динамика алелопатической активности водо-, спирторастворимых экстрактов, содержания фенольных соединений в вегетативных и генеративных органах пиретрума красного (*Pyrethrum coccineum* (Willd.) Worosch). Установлено, что наибольшее количество фенольных соединений накапливали листки и соцветия растений в фазе цветения. Выявлено наличие обратных корреляционных связей между количеством фенольных соединений и процентом ингибирования ростовых процессов биотестов.

Ключевые слова: Pyrethrum coccineum *(Willd.) Worosch., фенольные соединения, алелопатично активность*

Рекомендує до друку
Н.М. Дробик

Надійшла 30.08.2012

УДК 611.34+612.334+616.34-099

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МОРФОМЕТРИЧНА ОЦІНКА СТРУКТУРНИХ ЗМІН У ПОРОЖНІЙ КИШЦІ ПРИ ОТРУЄННІ ХЛОРИДОМ КАДМІЮ

Кадмій посідає одне з перших місць за своєю токсичністю й надходить в організм людини і тварин через слизові оболонки шлунково-кишкового тракту. Проведеним дослідженням структурних змін тонкої кишки експериментальних тварин встановлено виражену морфометричну перебудову структур стінки порожньої кишки. Токсична дія хлориду кадмію призводила до суттєвого порушення структурного гомеостазу досліджуваного органа на органному, тканинному та клітинному рівнях.

Ключові слова: морфометрія, порожня кишка, білі щури, хлорид кадмію

В умовах техногенного забруднення довкілля одним із пріоритетних завдань залишається вивчення особливостей дії найбільш поширених і небезпечних токсикантів довкілля, до яких належить і кадмій. Цей метал посідає одне з перших місць за своєю токсичністю і небезпекою для людини [1-4]. Реальна загроза забруднення біосфери даним ксенобіотиком обумовлена, насамперед, його стійкістю, розчинністю в атмосферних опадах, здатністю до сорбції ґрунтом,