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ALLELOPATHIC EFFECT OF CANADIAN GOLDENROD (*SOLIDAGO CANADENSIS* L.) ON SOYA AND CORN SEEDS GERMINATION

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Allelopathic effect of canadian goldenrod (Solidago canadensis L.) on soya and corn seed germination has been studied. There is direct relation between germination of soya and corn seeds and concentration of extract made of aboveground part and roots of canadian goldenrod (Solidago canadensis L.). Determined is the optimal concentration of the extract that provides low crops seeds germination.

Keywords: *canadian goldenrod*; corn; soya; allelopathy; concentration; seeds germination

Introduction. Allelopathy between plants is an integral part of their life in a biocoenosis that determines its species composition, structure and productivity. However, this interaction can be bivector one: in one case, some plant species inhibit other species, causing complete dominance, and reduce the total species composition in the biological community; in another case, some species have a positive effect on individual species, so that no obvious dominance occurs. Due to its properties, canadian goldenrod (*Solidago canadensis* L.) changes the structure of biocoenoses becoming a dominant plant and inhibiting other species grows. Allelopathy weightily acts in the compatibility of species as well as in interspecies

struggle for survival. Therefore, to control and regulate weeds successfully it is necessary to examine carefully their allelopathic abilities. It will allow developing effective methods of their biological control in agrocenoses.

Review of relevant literature. Each plant in the grouping can act as a producer or donor of physiologically active substances, their consumer or acceptor. Accordingly, we must differentiate allelopathic activity, i.e. the ability to create protecting biological sphere in direct/indirect way, and allelopathic tolerance (complex resistance) of a plant to colins. These features allow us to determine a plant role in the natural grouping. Chemical regulation in plant grouping consists in creating allelopathic area around itself [1, 2] that is accumulating colins. Allelopathic areas of all plants in coenosis are combining, which creates a certain level of colins. The higher the level, the weaker coenosis's members growth; the weaker growth and biomass accumulation the less colins are produced [4, 6]. Regarding allelopathy, each plant can be characterized by two main features: ability to form and secrete colins - physiologically active substances into environment and create conditions conducive to their accumulation in the environment; allelopathic tolerance or ability to resist to its active secretions or other plants ones and even need for their availability in the environment [2, 4].

Recently, in Ukraine there are more and more new weed species occur, among them is canadian goldenrod (*Solidago canadensis* L.), which came from North America. Its area of distribution is increasing, spreading danger on agricultural lands. The reason for the rapid spread of the species in Ukraine is the lack of natural competitors among insects or plants. Besides, seed production per plant of canadian goldenrod (*Solidago canadensis* L.) reaches 100,000 seeds that can be spread by wind over dozens meters with germination level of 95%. Taken together, these factors allow the plant to spread on more and more lands [3].

The goal of research was to determine the way canadian goldenrod (*Solidago canadensis* L.) affects the ability of corn and soya seeds to germinate.

Materials and methods. The study was carried out at the Herbology Department of the Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine

(IBCSB) in 2013/2014. Seeds were germinated according to a conventional method [4]. Corn and soya seeds for germination belonged to one certified seed lot. One repeat numbered 100 seeds. The experiment was repeated fourfold. The extract was prepared according to methods of P.P. Korostelev [5]. The concentration of the extracts was following: 1:1, 1:5, 1:10, 1:15, 1:20, 1:25. Distilled water served control treatment.

Two sheets of filter paper soaked with extract of certain concentration were put in a Petri dish. Seeds were placed on the paper. Petri dishes were covered with lids, then placed into incubator where incubated at the temperature of 22-25°C. The experiment was carried out for 20 days. Sprouted seeds of a crop were analysed every day in the first 5 days, then on the seventh and tenth days. Non-sprouted seeds were transferred to new Petri dishes and records were kept for another 10 days. The index of sprouted seeds was determined by the formula:

$$P = (a/b)\times 100;$$

Where P - index of sprouted seeds (%); a - number of germinated seeds of a crop; b - total number of seeds in the crop sample.

In addition, we investigated the mutual influence of corn, canadian goldenrod (*Solidago canadensis* L.) and soya seeds (Table 3), with crops germinating together on filter paper in Petri dishes. To this, same number of a crop seeds and canadian goldenrod (*Solidago canadensis* L.) seeds was taken (50 seeds), with fourfold repetition. Calculation of germination percentage for these crops was carried out when 50% of seeds in control treatment had germinated.

Results. As a result of the experiment, we obtained data on the effect of juice made from aboveground part and roots of canadian goldenrod (*Solidago canadensis* L.) on germination of corn seeds (Table 1) and soya seeds (Table 2).

As a result of studies, we found that extract of canadian goldenrod (*Solidago canadensis* L.) reduces laboratory germination of both maize and soya seeds to a different extent, due to not only species factor, but also part of weed and extract concentration.

Table 1. Allelopathic effect of canadian goldenrod (*Solidago canadensis* L.) on corn seeds germination in laboratory as affected by concentration of the extract (average for 2013/2014)

Concentration of the extract	Laboratory germination of seeds,%	
	Extract of aboveground part	Extract of roots
Control treatment (water)	90	92
1:1	10	5
1:5	24	17
1:10	41	31
1:15	88	82
1:20	90	87
1:25	93	91

Table 1. Allelopathic effect of canadian goldenrod (*Solidago canadensis* L.) on soya seeds germination in laboratory as affected by concentration of the extract (average for 2013/2014)

Concentration of the extract	Laboratory germination of seeds,%	
	Extract of aboveground part	Extract of roots
Control treatment (water)	88	89
1:1	6	3
1:5	14	11
1:10	26	17
1:15	79	76
1:20	84	79
1:25	87	83

The most expressed inhibition effect on the germination of corn and soya seeds showed extracts with the species concentrations of 1:1, 1:5, 1:10.

Table 3. Allelopathy of corn, soya and canadian goldenrod (*Solidago canadensis* L.) when germinating together (average for 2013-2014)

Treatment variation	% germination	Average length of embrio root for 96 hours, cm
Corn (control treatment)	89	5.1
Corn + canadian goldenrod	61/24	3.8/0.8
Soya (control treatment)	87	4.8
Soya + canadian goldenrod	57/31	3.1/0.6

As a result of studies it was found that canadian goldenrod (*Solidago canadensis* L.) seeds reduced qualitatively and quantitatively the percentage of corn and soya seeds germination when germinating together.

In general, canadian goldenrod (*Solidago canadensis* L.) was proved to be a weed inhibiting cultivated plants.

Conclusions. Maximum concentration extracts made from different parts of canadian goldenrod (*Solidago canadensis* L.) (1:1, 1:5, 1:10) can significantly inhibit germination capacity of a crop seeds. However, root extract made greater negative effect observed during seeds germination. At lower concentrations (1:15, 1:20, 1:25) allelopathy was not observed. Seeds of soya and corn germinated at 88% to 91% and 90% to 93%, respectively.

When seeds germinating together, canadian goldenrod showed inhibitory action towards crops (corn and soya). Germination of corn seeds dropped by 28% and soya seeds by 30%, as compared with a control treatment.

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