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## CROP PRODUCTION

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### USE OF GROWTH PROMOTERS AS ANTIDEPRESSANTS TO HERBICIDE IN BARLEY CROPS

Research article

#### Abstract

There are results of a study on growth promoters as antidepressants to a herbicide used on barley crops presented in this article. Weeds reduce crop yields. Herbicides are the main effective means of controlling weeds, but they are phytotoxic. Application of plant growth stimulants with herbicide reduces the pesticide load on the plant. The aim of the research was to study growth stimulators as antidepressants to herbicide on barley crops. It was found that herbicide Agritox reduces the number of weeds by 9,5 times. Its effectiveness is 91,4%. Efficiency of tank mixture of growth stimulators Ecopin and Biosil with herbicide Agritox was 85,5% and 87,5%. When spraying barley crops with herbicide Agritox, the yield increase was 0,24 t/ha; with the tank mixture of Agritox + Ecopin was 0,42 and Agritox + Biosil was 0,49 t/ha. Growth stimulants increased the number of plants by 14 and 20 pieces per m<sup>2</sup>, the number of grains per ear was increased by 3 pieces, weight of 1000 grains was increased by 0,8 and 1,5 g.

**Keywords:** barley, herbicide, plant growth stimulants, weeds, weed infestation, crop spraying.

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### ПРИМЕНЕНИЕ СТИМУЛЯТОРОВ РОСТА В КАЧЕСТВЕ АНТИДЕПРЕССАНТОВ К ГЕРБИЦИДУ НА ПОСЕВАХ ЯЧМЕНЯ

Научная статья

#### Аннотация

В статье представлены результаты исследования по изучению стимуляторов роста в качестве антидепрессантов к гербициду, применяемого на посевах ячменя. Сорняки снижают урожайность сельскохозяйственных культур. Гербициды являются основным действенным средством в борьбе с сорняками, но они фитотоксичны. Применение стимуляторов роста растений с гербицидом снижает пестицидную нагрузку на растение. Цель исследований – изучение стимуляторов роста в качестве антидепрессантов к гербициду на посевах ячменя. Установлено, что гербицид Агритокс снижает количество сорняков в 9,5 раза. Его эффективность составляет 91,4%. Эффективность баковой смеси стимуляторов роста Экопин и Биосил с гербицидом Агритокс составила 85,5% и 87,5%. При опрыскивании посевов ячменя гербицидом Агритокс прибавка урожая составила 0,24 т/га, баковой смесью Агритокс + Экопин – 0,42, Агритокс + Биосил – 0,49 т/га. Стимуляторы роста увеличили количество растений на 14 и 20 штук в 1 м<sup>2</sup>, количества зерен в колосе – на 3 штуки, массы 1000 зерен – на 0,8 и 1,5 г.

**Ключевые слова:** ячмень, гербицид, стимуляторы роста растений, сорные растения, засоренность посевов, опрыскивание посевов.

#### 1. Introduction

Increasing barley grain yields and quality is impossible without the use of modern crop protection products at present [1, P.100]. The phytosanitary situation is not always favourable in spring cereal crops, despite the increased supply of pesticides to farms. An increase in the weed infestation of crops is of particular concern [2, P.8], [3, P. 57].

Weed control in cereal crops is one of the most important areas of cultivation technology. Weeds reduce crop productivity, with an average loss of about 30%. Product losses can be more than 50% in the case of heavy weeding of crops [4, P. 35], [5, P. 35], [6, P. 23]. The main method of weed control is the use of chemical pesticides [7, P. 104]. But the chemical causes

damage to cultivated plants, almost all herbicides are phytotoxic. In this aspect, biological means of protection play an important role to reduce the chemical burden. They enhance physiological processes within plants. Plants need less time to recover thanks to biological preparations, and they enter the fruiting phase earlier [8, P. 23], [9], [10, P. 41].

Today, the protection of cereal crops against weeds is a priority in the plant protection system in the Republic of Mari El. Barley is highly clogged unlike other cereal crops, so obligatory herbicide treatment of crops is required. Most herbicides are quite toxic. Therefore, in addition to their primary function (protecting plants from weeds), they often have a negative effect on the main crop they are intended to protect. Plant stress effects can manifest themselves as stunted growth and metabolic disturbances, reduced germination, spotting, scorching, leaf curling, increased susceptibility to disease, and ultimately reduced yields [11, P. 127].

The use of growth promoters on crops together with herbicides will reduce the chemical load on the plants and improve their general condition [12, P. 72024]. It will take less time for the plants to regain their normal vigour.

The aim of our research was to study growth promoters as antidepressants to herbicide on barley crops.

## 2. Methods

The experiment was conducted in the Mari State University experimental field in 2020–2022.

Experiment scheme:

1. Control (no treatment);
2. Agritox (1,5 l/ha);
3. Agritox (1,5 l/ha) + Ecopin (20 g/ha);
4. Agritox (1,5 l/ha) + Biosil (30 ml/ha).

Spraying of the crops with herbicide and growth stimulants was carried out in the phase of full tillering. The weather was clear and the wind was light. The working fluid consumption was 200 l/ha.

Phenological observations of barley growth and development were carried out in the experiment; account of the amount of weeds by the All-Russian Institute for Plant Protection method; estimate of biological effectiveness of preparations use; barley yield account.

The barley variety Vladimir was used for sowing. Seed quality corresponded to the first seeding class. Seeding rate was 200 kg per hectare. Soil of the experimental plot is sod-podzolic medium-loamy. Agrochemical indicators: humus content was 2,2%, pH (saline) was 5,7, phosphorus was 17 mg/100g of soil, potassium was 12 mg/100g of soil. Agrotechnique of cultivation corresponded to the generally accepted technologies of our Republic. We conducted husking and plowing in autumn after the harvest of the forecrop (vetch + oats). We also did the harrowing, cultivation and rolling in the spring.

Ecopin is a natural biostimulant and anti-stressant for plants, a biological preparation. Ecopin contains poly-beta-hydroxybutyric acids plus terpenic acids and a set of nutrients. It is an excellent growth and development stimulator. It strengthens the immunity of the plants to diseases and stresses, and activates their vitality. A set of nutrients included in the preparation promotes the growth and development of young plants.

Biosil is a natural eco-friendly growth regulator that increases plant resistance to diseases and adverse environmental conditions. It has a powerful stimulating effect on metabolic processes in plant organs and tissues. The active ingredient of Biosil is triterpene acids extracted from Siberian silver fir (*Abies sibirica*) needles.

## 3. Results and discussion

The results of weed control showed that in the agrocenosis of spring barley the following perennial weeds prevailed: *Equisetum arvense* L., *Taraxacum officinale* Wigg, the juvenile weeds: *Chenopodium album* L., *Fumaria officinalis* L., *Galium aparine* L., *Stellaria media* (L.) Vill., *Polygonum convolvulus* L. The majority of weeds were juvenile weeds – 83,5% to 90,3% of the total number of weed plants. Of the perennial weeds, *Equisetum arvense* L.

The number of weeds was 9,5 times lower after spraying barley crops with herbicide Agritox. Their total number was 13 per 1 m<sup>2</sup>. High effectiveness of this herbicide was against juvenile weeds. The number of perennial weeds was reduced by 4,7 times. The number of weeds was 11,7 times less compared to the control. Biological effectiveness of herbicide Agritox was 91,4% against weeds. Efficiency of a tank mixture of growth stimulators and herbicide was 85,5% (Agritox + Ecopin) and 87,5% (Agritox + Biosil) against weeds. In contrast to the chemical in pure form, weeds such as *Equisetum arvense*, *Taraxacum officinale* and *Stellaria media* survived more in variants with stimulants. Agritox in its pure form managed better with perennial weeds in contrast to a tank mixture of it with growth stimulants (Table 1).

Table 1 – Biological effectiveness of herbicide and growth promoters against weeds

Variants	Number of weeds, pcs./m <sup>2</sup>		Biological efficiency, %
	before treatment	after treatment	
1. Control	114	152	-
2. Agritox	124	13	91,4
3. Agritox + Ecopin	124	22	85,5
4. Agritox + Biosil	128	19	87,5

Accounting for weeds showed that the number of weeds increased by 38 units/m<sup>2</sup> in the control. After treatment with herbicide and tank mixture the number of weeds decreased in the second variant by 111, in the third by 102 and in the fourth by 109 units/m<sup>2</sup>. Compared with the control, the number of weeds decreased by a factor of 11-7. The proportion of perennial weeds before crop spraying was about the same in all variants and amounted to 10–15% of the total number of weeds (Fig. 1).

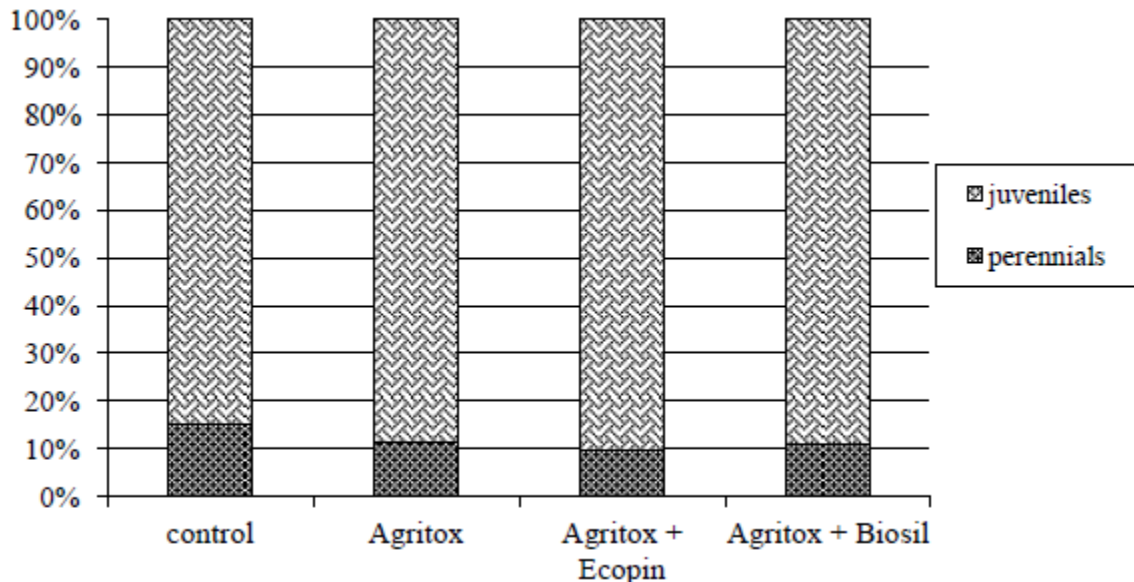


Fig. 1 – Percentage of perennial and juvenile weeds before spraying

The situation changed after spraying. The proportion of perennial weeds remained about the same (15-16%) on the control variant. In the third and fourth variants the proportion of perennial weeds increased (Fig. 2).

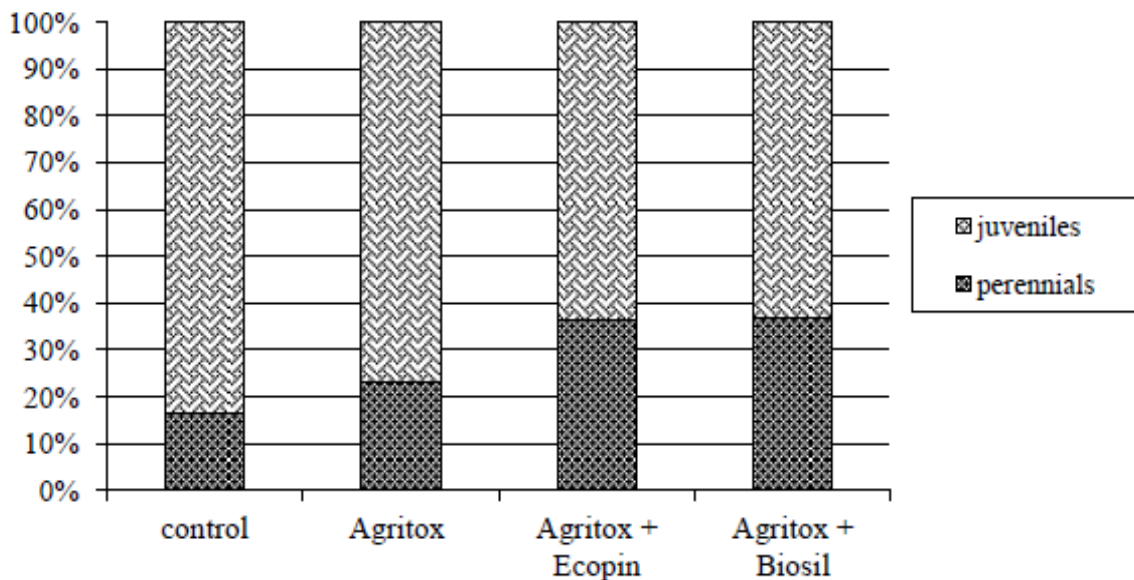


Fig. 2 – Percentage of perennial and juvenile weeds in total after spraying

The percentage of perennial weeds was 22% in the variant with Agritox in pure form and 36-37% in the variants with growth stimulants.

Herbicide application increases the yield of spring barley (Table 2).

Table 2 – Barley yield and yield structure

Variant	Yield, t/ha	Number of plants per m <sup>2</sup> , pcs.	Ear length, cm	Number of grains per ear, pcs.	Weight of 1000 grains, g
1. Control	1,74	306	7,2	15	36,7
2. Agritox	1,98	316	8,4	17	36,2
3. Agritox + Ecopin	2,16	320	8,8	18	37,5
4. Agritox + Biosil	2,23	326	8,7	18	38,1
SSD <sub>05</sub>	0,18	8,31	0,26	1,5	0,33

Note: SSD – smallest significant difference

The data in the table show that barley yield increased by 0,24 t/ha when spring barley crops were sprayed with herbicide Agritox compared to the variant without spraying. Yield of barley increased by 0,42 t/ha after spraying with Agritox + Ecopin. Yield gain from Ecopin growth stimulant was 0,18 t/ha. Biosil mixed with herbicide had a significant effect on increasing the yield of spring barley. The yield increase was 0,49 t/ha compared to the control. The gain from Biosil growth stimulant was

0,25 t/ha. Comparing the two biopreparations, we see that Biosil showed the best results. Yield of spring barley is higher by 0,07 t/ha compared to Ecopin.

The use of the growth promoters Ecopin and Biosil together with the herbicide as an antidepressant helped to increase yield structure indices. The number of plants on Ecopin was higher than the control by 14 units and on Biosil by 20 units. The length of the ear was greater by 1,6 and 1,5 cm. The number of grains in the ear was 3 more. The weight of 1000 seeds was 0,8 g and 1,5 g more than the control, respectively.

Both growth stimulants worked well as an antidepressant and contributed to increased yields. However, Biosil showed the best results.

#### 4. Conclusion

1. Spraying of crops with herbicide Agritox reduced the number of weeds by 9,5 times. Biological effectiveness of the herbicide was 91,4%, in mixture with growth stimulant Ecopin it was 85,5% and Biosil it was 87,5%. After spraying with the tank mixture, the percentage of perennial weeds was higher than in the control and was 34-35%.

2. Yields increased by 0,24 t/ha when the barley crop was sprayed with the herbicide Agritox. From the tank mixture Agritox + Ecopin increased by 0,42 t/ha. The highest barley yield was obtained in the variant with spraying Agritox + Biosil. Yield increase was 0,49 t/ha. Growth stimulants increased the number of plants by 14 and 20 pcs/m<sup>2</sup>, the ear length increased by 1,6 and 1,5 cm, the number of grains in an ear increased by 3 pieces, and the weight of 1000 grains increased by 0,8 and 1,5 g.

#### Conflict of Interest

None declared.

#### Конфликт интересов

Не указан.

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