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SPECIAL FEATURES OF PROTECTING COMMON MILLET AGAINST WEEDS

Specific character of protecting common millet crops against weeds is studied. The tank mixture Agrotox + Basagran + Lontrel is found out to be a promising composition for controlling weeds on millet crops. Ways to control annual gramineous weeds in millet crops are considered.
Key words: *panic grass, weeds, herbicides, antidotes*

Introduction. The yield capacity of millet crops is reduced in the highest degree because of their high weediness. One of the reasons of the low competitive ability of plants of said crop in resisting to weeds is slow growth and development thereof in the period from seedling emergence to shooting stage. The other reason lies in the fact that millet crops are weeded both with the weeds characteristic to all cereal crops and those specific, which have biological and certain morphological properties similar to the millet. The following weeds are related thereto: panic grass, yellow foxtail and green foxtail [1, 2]. This in turn is caused by the fact, that by virtue of high need in warmth, millet is sown, when speed growth of plants of various species and biological groups of weeds occurs. If the number of diseases in millet, as a rule, is not too large, then the weediness of crops brings to large yield losses, as species composition of wild plants is very large and knowledge of biological special features of weed plants is necessary for effective protection against them [1, 2].

Materials and methods. The programme of research on monitoring the species composition of weeds in millet crops and protection thereof using herbicides provides for carrying out spraying millet plants at the stage of tillering thereof with a complex of preparations.

The experimental design:

1. Control – no herbicides.
2. Agritox (MCPA) 500 g/l aqua solution (aq. sol.) Application rate – 1.2 l/ha.
3. Basagran, 48% aq. sol. (Benazon) – 3.0 l/ha.
4. 2,4-D, 50% aq.sol. (2,4-dichlorophenoxyacetic acid as dimethylamine salt) – 1.3 l/ha.
5. Basagran, 48% aq. sol. + Agritox, 50% aq. sol. – 1.5 і 0.6 l/ha відповідно.
6. Basagran, 48% aq. sol. + Agritox, 50% aq. sol. + Lontrel, 300 aq. sol. – correspondingly 1.5; 0.3 and 0.5 l/ha.
7. Control – for consecutive hand weeding.

Maintaining records on vegetative mass of weeds, assessing the content of dry matters therein and determining the value of carrying-over nutrient elements by weeds were carried out using generally accepted methods [3].

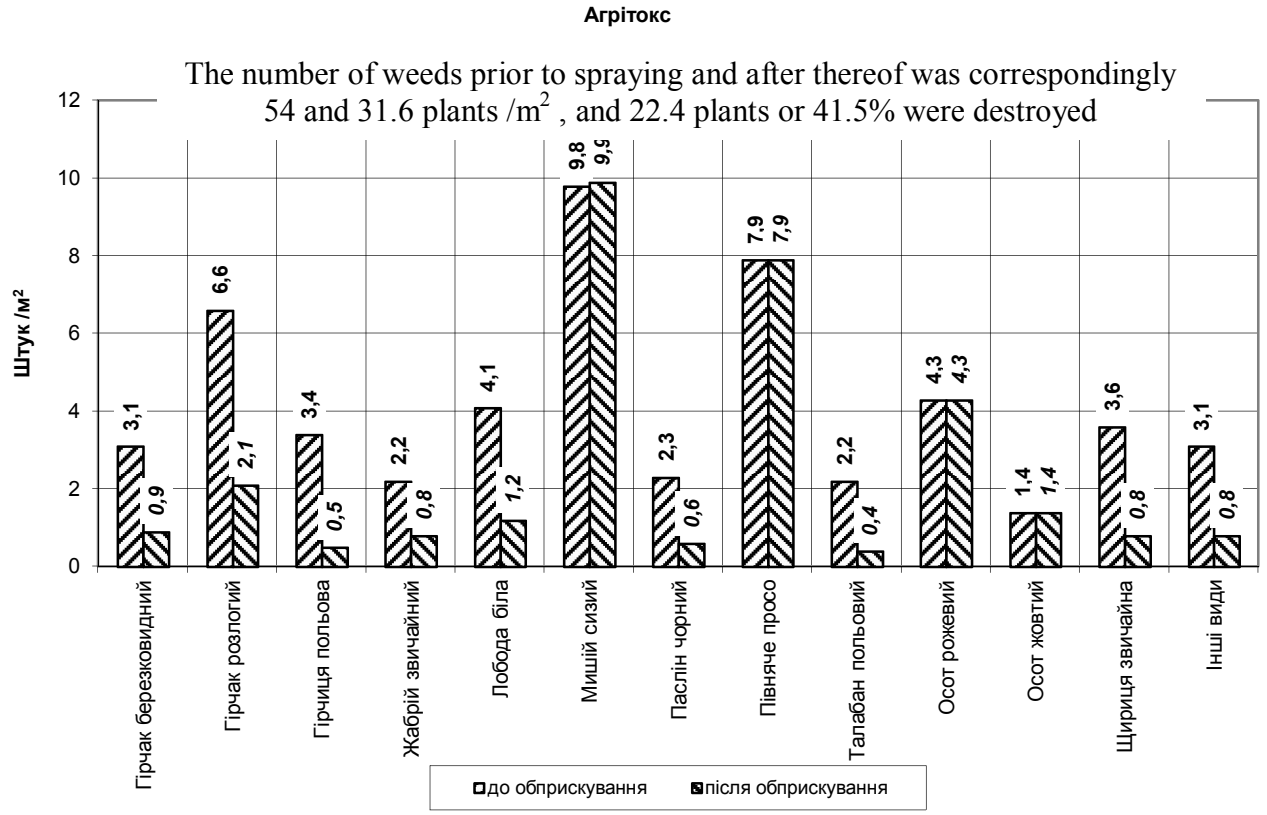
The antidote activity of 1,8-naphthalic anhydride (1,8-NA) to graminicides was studied in the conditions of the greenhouse complex of the Institute of Organic Chemistry of the National Academy of Sciences of Ukraine (NAS of Ukraine). Prior to sowing the millet seeds were treated with 1,8-NA. The antidote was diluted in ethyl alcohol while heating thereof and converted into a working aqueous solution achieving the 0.5% end concentration of 1,8-NA. The seeds were treated with a working solution containing a sticking agent for 30 min. in an equivalent of 20 l solution per ton of seeds. The seeds were sown into a mixture of soil:sand 1:1 and grown in the conditions of the

greenhouse complex of the Institute of Organic Chemistry of NAS of Ukraine. In 2 weeks the plants were treated with herbicides, merging the above-ground part thereof into solutions of preparations for 5 min. at 23 ^{o}C. Maintaining the records was started in 7 days after the treatment.

Results and discussion. The millet crops in the years of research have a mixed character of weediness. The structure of weediness was significantly changed by years, yet the composition of species thereof was rather stable. The weeds in millet crops were preferably represented by spring early and late biological species, which grow and develop simultaneously with a cultivated plant. Average weediness of the crops in the years of research was 68.5 plants/m^2. The following species were considered as the most wide-spread: yellow foxtail (*Setaria glauca (L.)Pal. Beauv.*) above 18%, panic grass (*Echinochloa crus-galli (L.)Pal. Beauv.*) above 14%, redroot pigweed (*Amaranthus retroflexus L.*) – 10.9%, common lambsquarters (*Chenopodium album L.*) – 7.1%, field mustard (*Sinapis arvensis L.*) – 6.6%, pale smartweed (*Polygonum lapathifolium L.*) – 5.9%, wild buckwheat (*Polygonum convolvulus L.*), field thistle (*Cirsium arvense L.*) – 5.7% and other species.

By the period of maintaining records on weed plants (records were maintained on the control - no herbicides) prior to spraying of millet crops with herbicides the least number of yellow foxtail seedlings was 6.5 plants/m^2 and the largest – 16.7 plants/m^2. For the years of research their average number was 12.9 plants/m^2. The least number of seedlings of common lambsquarters was 1.8 plants/m^2, the largest – 6.7 plants/m^2.

Changes in weed numbers in the variant of using the herbicide Agritox is given on Ill. 1.



Ill. 1. Effect of the herbicide Agritox on the numbers of weed species in millet crops:

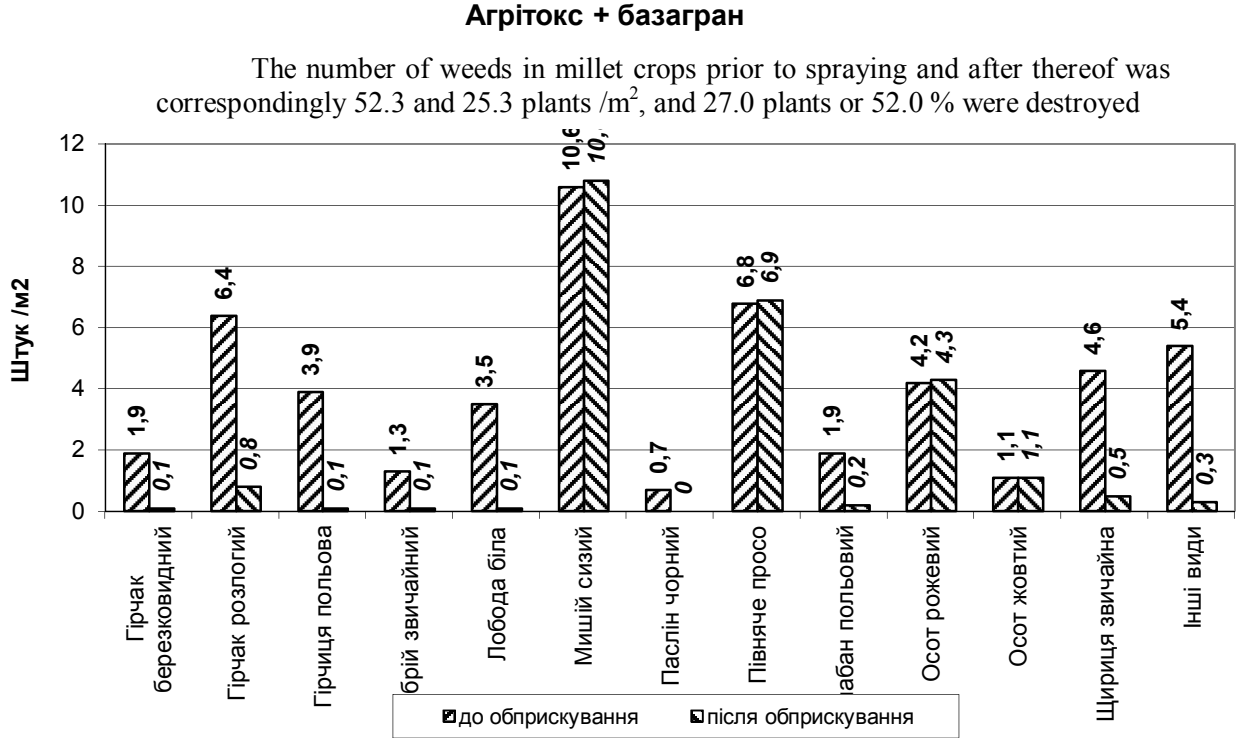
The Heading (from above): Agritox

The axis of abscisses (from left to right): 1) wild buckwheat; 2) pale smartweed; 3) field mustard; 4) common hemp-nettle; 5) common lambsquarters; 6) yellow foxtail; 7) black nightshade; 8) panic grass; 9) field penny-cress; 10) field thistle; 11) field sow thistle; 12) redroot pigweed; 13) other species.

The axis of ordinates: plants/m^2; Conditional signs: prior to spraying; after spraying

The significant effect of Agritox was observed on such species as wild buckwheat and pale smartweed, field mustard, common hemp-nettle, common lambsquarters, black nightshed, field penny-cress, redroot pigweed and others; at the same time, yellow foxtail, panic grass, field thistle and field sow thistle were not destroyed at all by said herbicide. The percentage of the destroyed weeds was 41.5%.

The tank mixture Agritox + Basagran had a somewhat stronger destroying effect on the composition of weed species (Ill. 2).



Ill. 2. Effect of the herbicides Agritox + Basagran on the numbers of weeds in millet crops:

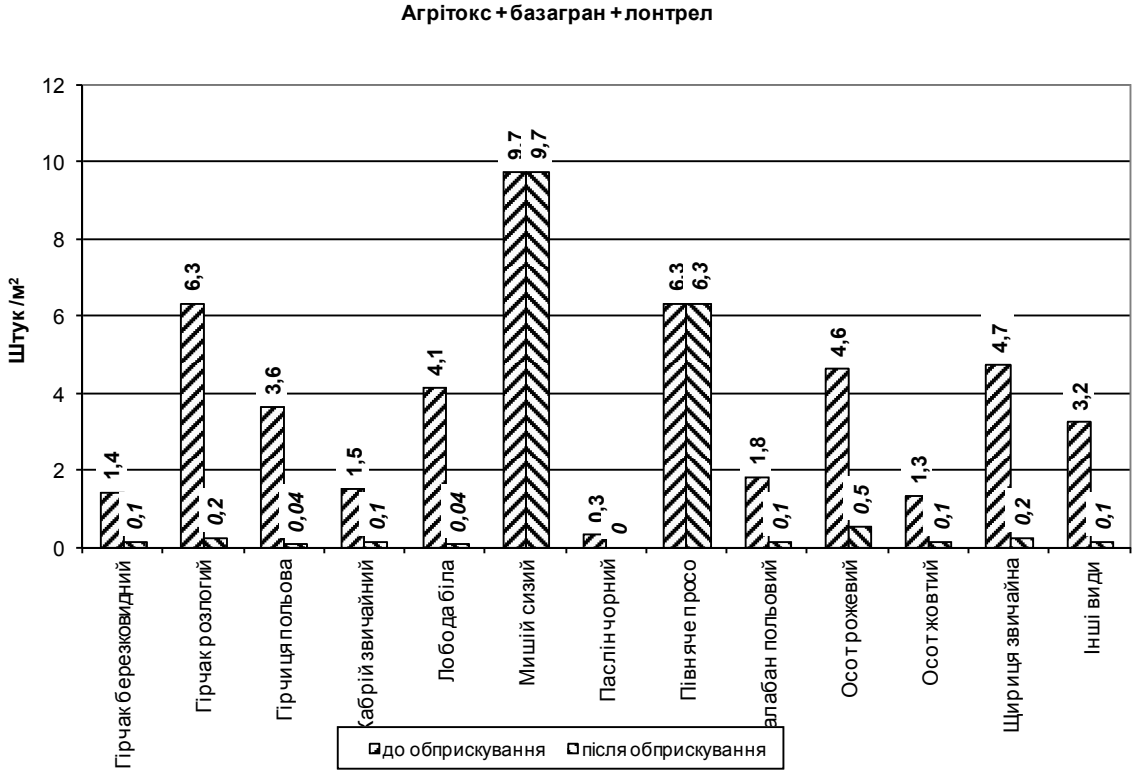
The Heading (from above): Agritox + Basagran

The axis of abscisses (from left to right): 1) wild buckwheat; 2) pale smartweed; 3) field mustard; 4) common hemp-nettle; 5) common lambsquarters; 6) yellow foxtail; 7) black nightshade; 8) panic grass; 9) field penny-cress; 10) field thistle; 11) field sow thistle; 12) redroot pigweed; 13) other species.

The axis of ordinates: plants/m^2; Conditional signs: prior to spraying; after spraying

The tank mixture of the herbicides Agritox + Basagran almost fully destroyed wild buckwheat and pale smartweed, field mustard, common hemp-nettle, common lambsquarters, black nightshade, field penny-cress, redroot pigweed and others; yet absolutely not affected yellow foxtail, panic grass, field thistle and field sow thistle. A part of destroyed weeds increased up to 52%.

At adding Lontrel to the previous tank mixture, effect of action of said mixture on the composition of weed species achieved 64.2%. In doing so, wild buckwheat and pale smartweed, field mustard, common hemp-nettle, common lambsquarters, black nightshade, field penny-cress, field thistle and field sow thistle, redroot pigweed and other weeds were almost fully destroyed, yet there was no signs of affecting yellow foxtail and panic grass by said herbicide (Ill. 3).



Ill. 3. Effect of the herbicides Agritox + Basagran + Lontrel on the number of species of weeds in millet crops.

The Heading (from above): Agritox + Basagran+Lontrel

The axis of abscisses (from left to right): 1) wild buckwheat; 2) pale smartweed; 3) field mustard; 4) common hemp-nettle; 5) common lambsquarters; 6) yellow foxtail; 7) black nightshade; 8) panic grass; 9) field penny-cress; 10) field thistle; 11) field sow thistle; 12) redroot pigweed; 13) other species.

The axis of ordinates: plants/m^2; Conditional signs: prior to spraying; after spraying

The weeds manifest a typical strategy of explerent plants, they actively use a combination of favourable conditions to fill free ecological niches. In such a period weak and underdeveloped millet plants cannot resist to processes of weed overgrowth. At the further growth stages cultivated plants become not only resistant to weeds, but they themselves suppress them [4,5]. This partially explains the fact that, as compared with the tillering stage, at the stage of full maturation of grain lowering of crops weediness was observed in all variants.

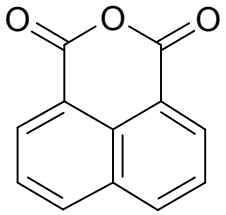
The majority of plants of different weed species after coming out onto the soil surface consume reserves of plastic substances of endosperm of a caryopsis and establish a principally new source of energy nutrition, in particular photosynthesis, intensively increase the root system, leaf apparatus area and increase their height. The favourable weather conditions, necessary amount of moisture, mineral substances in soil provide an accelerated increase in leaf surface of weeds and, at the absence of protection, aggravation of competitive relations not with plants of the crop only, but also between wild plants [6, 7]. Arranging millet leaves above the soil surface provides coming of sunrays to young green plants and an opportunity to avoid shading from closely arranged competitive plants.

Maintaining records and observing the processes of weed overgrowth on millet crops give clear indications on the fact that in the course of a month from the time of mass emergence of

seedlings on a field all the places free of plants of the crop have already closed leaves of weed plants. After forming the phytocenosis stage on millet crops, the intensity of appearance of new weed plants gradually reduces, and in millet plants the following processes occur: a speedy increase in the habitus of height and the area of leaves thereof.

The availability of gramineous weed species, especially at the initial stages of development of the crop, turned to be a complex problem of weed overgrowth in millet crops. Said problem can be solved by means of using anti-gramineous herbicides, that is graminicides, selective to millet, first of all, Phenoxaprop and Pinoxaden and compounds closed thereto by their structure. The level of control of the gramineous weeds can be raised also by means of using antidotes, which enhance the millet's resistance to herbicides.

The 1,8-naphthalic anhydride (1,8-NA) is a known commercial antidote [8,9,10]. The structure of 1,8-NA is given on Ill. 4.



Ill. 4. Structural formula of 1,8-naphthalic anhydride (1,8-NA)

Table 1

Effect of 1,8-naphthalic anhydride on damage of millet plants with herbicides

No	Variants of experiment	The level of phytotoxicity*, %
	Herbicide (10^{-6} M) + 1,8-NA	
1	Control	0
2	Furore 10^{-7} M	70
3	Furore 10^{-6} M	100
4	Furore 10^{-7} M + 1,8-NA	25
5	Furore 10^{-6} M +1,8-NA	95
6	Pinoxaden 0,5 x 10^{-7} M	85
7	Pinoxaden 10^{-7}M	100
8	Pinoxaden 10^{-6} M	100
9	Pinoxaden 0.5 x 10-7 M + 1,8-NA	85
10	Pinoxaden 10-7M + 1,8-NA	95
11	Pinoxaden 10-6 M + 1,8-NA	100
12	1,8-NA	5
HIP $_{0,05}$		6

*Note: * – reduction in weight of dry matters of the above-ground part of millet plants for 7 days after treatment with graminicides.*

Treatment of the seeds with 1,8-NA did not cause the proved damages of millet plants (Table 1). It is necessary to note that insignificant drying of the ends of leaves, which can be caused by the effect of the formulation of the antidote.

Treatment of the millet seedlings with Furore in a concentration of 10^{-6} M caused death of plants of said crop. Reduction in the concentration of the graminicide also damaged the millet plants. Pinoxaden in a concentration of 10^{-6} M gave a more expressive graminicide effect. Just a 20-time reduction of concentration of a working solution caused a noticeable lowering of the phytotoxicity of Pinoxaden.

The antidote activity of 1,8-NA manifested itself as regards to the reduced concentrations of graminicides, first of all, Furore. An increase in their concentrations levelled the effect of 1,8-NA.

Conclusions. The tank mixture Agrotox + Basagran + Lontrel is revealed to be a promising composition for control of weeds in millet crops. It almost fully destroyed such weeds as wild buckwheat and pale smartweed, field mustard, common nettle-hemp, common lambsquarters, black nightshade, field penny-cress, field thistle and field sow thistle, redroot pigweed and other weeds but had no effect on yellow foxtail and panic grass.

At present control of annual gramineous species of weeds in millet crops still remains a task not yet solved. Attempts to find the graminicides, selective as regards to millets, failed. The antidote 1,8-NA can be used for protecting millet plants against the effect of post-emergent graminicides (Furore etc.), provided that the herbicides are used in low rates.

It is believed that it is expedient to determine the effectiveness of antidotes, which, by mechanism of action thereof, relate to inducers of glutathione synthesis, inducers of plant monooxygenases and inducers of xenobiotic metabolism as possible components of technologies to use graminicides on millet crops.

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Анотація

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Особливості захисту посівів проса посівного від бур'янів

Досліджено особливості захисту посівів проса посівного від бур'янів. Встановлено, що композиція Агрітокс + Базагран + Лонтрел є перспективною для контролю бур'янів на посівах проса. Розглянуто шляхи контролю й однорічних злакових бур'янів у посівах проса.

Ключові слова: *просо посівне, бур'яни, гербіциди, антидоти*

Аннотация

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Особенности защиты посевов проса посевного от сорняков

Исследованы особенности защиты посевов проса посевного от сорняков. Установлено, что композиция Агритокс + Базагран + Лонтрел является перспективной для контроля сорняков на посевах проса. Рассмотрены пути контроля и однолетних злаковых сорняков в посевах проса.

***Ключевые слова**: просо посевное, сорняки, гербициды, антидоты*