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CHEMICAL PROTECTION OF SOYBEAN CROPS AGAINST WEEDS

Shcatula Y.
Candidate of Agricultural Sciences,
Associate Professor of agriculture, soil science and agrochemistry department
Vinnytsia National Agrarian University
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ABSTRACT

One of the most pressing problems in the development of domestic agriculture is the significant weeding of crops, including soybeans. Soil and climatic conditions of Ukraine mainly contribute to the cultivation of this crop.

At the beginning of the growing season, soybeans grow relatively slowly, and weeds compete with them for moisture, nutrients, light use, and so on. This results in low crop competitiveness compared to weeds. Yield losses from weeds can average 30 to 50%, and sometimes they can die completely.

To control weeds in soybean crops should use soil herbicide Frontier® Optima k.e., 1,0 l/ha + in phase 5 trifoliate soybean leaves post-emergence herbicide Korum p. K., 1,5 l/ha + South Africa Metholate, 1,0 l/ha + in the phase of the beginning of soybean budding foliar application of the microfertilizer Quantum - Molybdenum Chelate (Mo), 0,5 l/ha, as a result of which it is possible to obtain soybean seed yield at the level of 2,94 t/ha.

Keywords: Soy, agrocenosis, technology, weeds, herbicides, seeds, yield.

Formulation of the problem.

Soybeans are a universal legume and oilseed, the seeds of which are used for food, fodder and technical purposes. Among annual cereals and legumes in terms of protein content and quality, it ranks first, and the amount of oil is second only to peanuts. In the group of field oilseeds, soybeans provide the highest yield of cake and meal.

The production of this culture at the global level is growing rapidly, it largely depends on the food security of civilization. It is grown in major agricultural regions in 90 countries. World production of this crop has reached 253 million tons. Its crops absorb 20 million tons of biological nitrogen. Due to it, the world economy receives more than 128 billion dollars a year [1].

High yields, extreme stress resistance, powerful return of each sown hectare at low production costs can not leave indifferent any farmer. No other crop is able to ensure the accumulation of such an amount of protein and oil, even with very high soil fertility, sufficient levels of headlights and intensive watering. Under favorable weather conditions in 2018, the gross harvest of soybeans in Ukraine reached 4,3 million tons, which brought our country to 8th place among its world producers. However, the potential of the crop is much higher: in Europe, one hectare produces an average of 3-4 tons of grain, while in Ukraine only 2 tons. The main reason is high weediness and insufficiently effective protection of soybean crops [10].

With the development of intensive technologies for growing crops, scientists Zabolotny O.I., Zabolotna A.V., [4] state that to reduce the negative impact of herbicides on cultivated plants, it is advisable to combine their use with biological drugs, under the influence of which metabolic processes increase plants, develops a stronger aboveground and underground mass, the optimal photosynthetic apparatus is formed, which in general ensures the growth of crop productivity.

Therefore, the development of the most efficient, least economically and environmentally friendly weed control system using chemical plant protection products for growing soybeans in different farming systems is an extremely important element of innovative development in crop production.

Analysis of recent research and publications.

Glycine max (L.) Merrill is the main legume in the world. It belongs to the strategic cultures and meets the most basic needs of mankind.

Soybeans are a very popular type of legume that is used in many areas of food and industrial production. These products are in demand in the wholesale market, so it makes sense for farms to work towards soybean production. Interest in growing this crop continues to grow as new opportunities open up for its marketing

abroad, especially in a country like China, the world's largest importer of soybeans.

As the world's main grain legume, soybeans are grown in a large agricultural belt on an area of over 85 million hectares. In terms of sown area, it ranks fourth in the world after wheat, rice and corn. Since the mid-1970s, world soybean production has increased from 30 to 200 million tons [9].

Soybeans have a high rate and volume of world production because it has a growing demand in the market, helps to solve the following urgent tasks: increase grain production; vegetable protein production; oil production; replenishment of soil nitrogen reserves; strengthening the economy. In the future, the scale of world production and the direction of use of this culture will expand.

One of the most pressing problems in the development of domestic agriculture is the significant weeding of crops, including soybeans. Soil and climatic conditions of Ukraine mainly contribute to the cultivation of this crop.

Obtaining high and sustainable soybean yields is based on high agricultural crops: the latest varietal composition, pre-sowing tillage and sowing, comprehensive control of weeds, pests and diseases, harvesting and post-harvest processing. At the beginning of the growing season, soybeans grow relatively slowly, and weeds compete with them for moisture, nutrients, use of light, and so on. This results in low crop competitiveness compared to weeds. Yield losses from weeds can range from an average of 30 to 50%, and sometimes they can die completely.

Soybeans are left with weeds for 2-3 weeks from sowing to the appearance of the first trifoliate leaf. At this time, the future harvest is genetically laid down. If soy is not protected at this time, it genetically reduces the yield potential, and this process is irreversible. The most optimal period for weed control is the phase from the first to the third trifoliate leaf of the crop (this is the period from which soybeans are most "resistant" to action against dicotyledonous and cereal herbicides) [3].

At the beginning of the growing season, soybeans are quite competitive against weeds due to the significant reserves of plastic substances in the seeds and intensive growth. But later, the short length of the stem, slow growth in the initial period of development, low crop density (50-60 pieces/m^2) do not allow it to compete with weeds. Therefore, field litter is a significant obstacle to obtaining high and stable soybean yields. During the critical growing season on a weed background, soybeans significantly reduce their productivity. According to generalized long-term data, each quintal of raw mass of weeds causes a shortage of more than 13 kg of soybean seeds [12].

Weeds are one of the main factors limiting the production of soybean seeds. They reduce crop productivity through competition for nutrients, light and water, and serve as a breeding ground for pests, pathogens and other pathogens.

A number of scientists Shevchenko M.S., Shevchenko S.M., Derevenets-Shevchenko K.A., etc., in their work note that the decrease in gross harvest of crops due to weeds is 25-30%, in some cases exceeding 50% [14].

By absorbing large amounts of nutrients from the soil, weeds impair the normal growth and development of cultivated plants. Due to the lack of appropriate measures to protect crops, weeds are able to absorb 160-200 kg/ha of nitrogen, 55-90 kg/ha of phosphorus and 170-250 kg/ha of potassium [5].

One of the main reasons for the decline in crop yields is the high weediness of crops. It is determined by the potential stock of weed seeds in the soil and its long-term viability.

The higher the stock of seeds and organs of vegetative reproduction of weeds in the soil, the more it will germinate under favorable conditions in subsequent years. Despite the intensive use of herbicides in the cultivation of crops, the potential weediness of the arable layer is not reduced [8].

The total stock of weed seeds that can germinate in crops is too large for crops to compete with them. In addition, not all weeds germinate at the same time, but have a long period of germination during almost the entire growing season.

Surveys of arable land conducted in different regions of Ukraine revealed that at the turn of 2000, the average stock of weed seeds in the arable soil layer (0-30 cm) was 1,47-14,2 billion units/ha. At this level of potential soil weeding, the number of weeds many times exceeded the thresholds of harmfulness and guaranteed the emergence during the growing season from 2 to 5 thousand pieces/m^2 of their seedlings [6].

Weed populations are almost ubiquitous in the structure of agrophytocenoses, forming for each field its species composition and number of individual weed species, as well as the potential stock in the soil of their seeds and vegetative reproductive organs. Well-known Ukrainian herbologist Ivashchenko II notes that modern weed populations have acquired a set of features that allow them to withstand intense anthropogenic impact, both mechanical and chemical [5].

Therefore, in crop crops it is extremely important to regulate the species composition of weeds, taking into account the biological characteristics of their development, distribution routes and control measures. The system of protection of soybean plants should be aimed both at the destruction of segetal vegetation and at preventing the formation of seeds. It is important to use in crop rotation units with high weed efficiency and increase the competitiveness of field crops in agrophytocenoses. Successful solution of these problems leads to the improvement of biological productivity of crops, including soybeans, improving the quality of the crop and the economic feasibility of its cultivation.

One of the most important elements of technology that frees soybeans from competition is protecting them from weeds with herbicides. The choice of herbicide should take into account the species composition of weeds of each agrocenosis. Knowing the history of the field over the past years and taking into account the predecessor, you can more effectively choose the active substance of the herbicide or a mixture of several active substances.

An integral part of intensive soybean production technology is the use of effective post-emergence herbicides that can effectively control weed infestation. Modern post-emergence herbicides, including preparations containing two or more active substances, provide significant productivity of soybean crops with high grain quality. To increase the economic efficiency of herbicide application, tank mixtures of several preparations and several application periods should be used. Mixtures of post-emergence herbicides with the addition of complexes of microfertilizers and biologically active substances are highly effective. This significantly reduces the possibility of resistance in most weeds. Rational weed control using microfertilizers provides high weed competitiveness, accelerates the growth and symbiotic potential of the crop, accelerates the yield and improves the biochemical quality of the product.

Thus, the intensive technology of soybean cultivation involves the use of chemical plant protection measures, which leads to an increase in pesticide load on agrocenoses and the environment. To reduce the toxic effects of herbicides, reduce their consumption rates, it is necessary to use herbicide compositions and microfertilizers in soybean cultivation technology, but the main attention should be paid to proper crop rotations and scientifically sound tillage systems.

The purpose of the study is to substantiate the feasibility of using soil and post-emergence herbicides to control weeds and foliar application of microfertilizers in soybean agrocenoses in the experimental field of VNAU village Agronomichne.

Presenting main material.

In the modern sense, agrophytocenoses are characterized by a certain floral composition, structure, relationships of plant organisms with each other and the natural environment, self-regulation, dynamism and historicity, but differ from natural formations in that they are artificially created and maintained only by constant human effort. The main structural components of agrophytocenoses are populations of cultivated plants and weeds, the initial parameters of the latter are largely influenced by humans.

The concept of modern integrated protection of cultivated plants from weeds provides: prevention of replenishment of the seed bank of weeds in the soil by reducing their seed productivity and inflow from the outside; reducing the intensity of weed seed germination from the existing bank in the soil to natural death; provocation and friendly germination of weed seeds in the pre-sowing and post-harvest periods with the subsequent destruction of their seedlings by tillage tools; strengthening the competitiveness of cultivated plants against weeds, which eliminates or significantly reduces the formation and entry of weed seeds into the soil.

Controlling the number of weeds in the crops provides an opportunity to respond in a timely manner and eliminate possible problems, and to successfully control the number of weeds, you need to have complete information about their quantitative and species composition. One of the means of control is the constant monitoring of weed distribution in crops [7].

Species diversity of weeds has expanded significantly in recent decades. Along with common weeds, there are species that were characteristic only of a certain soil and climatic zone. The main reasons for the increase in weediness of field agrophytocenoses are, first of all, significant reserves of viable seeds and organs of vegetative reproduction of weeds in the soil, due to the specialization of farms on extremely profitable crops, crop rotation, withdrawal of some technological operations from cultivation. soil, application of high doses of nitrogen fertilizers, violation of methods and terms of grain harvesting, high cost of herbicides, etc.

One of the factors influencing the species composition of weeds in the fields is natural, but much more than natural conditions, the species composition and number of weeds depends on the biological properties and agricultural techniques of cultivation.

The species composition of weeds is formed depending on their adaptability and structure of sown areas of crops. Weed dominance in the agrobiocenosis is based on herbicide resistance, a wide range of seed germination, morphological plasticity and the presence of neotenic features [13].

The joint growth of weeds and cultivated plants of different species in agrophytocenoses is due to their ecological and biological specificity, as well as the unusual conditions of growth. Due to the growth in agrophytocenoses of a significant amount of weeds, between sown crops and weeds intensifies competition for light, moisture, nutrients, which ultimately affects the level of crop yields and quality of crop products. Their distribution largely depends on abiotic, biotic and agrotechnical factors.

The actual species composition of weeds in crops of different crops is formed depending on the biological characteristics of a particular crop, soil and climatic conditions of the zone and cultivation technologies. The distribution of weeds and their species composition in crops of certain crops is determined by the ecological characteristics of individual species, ie their relationship to the main environmental factors - heat, moisture, light, etc.

Not only biological groups but also individual weed species react differently to weather conditions. Thus, in conditions with high soil moisture, field axes, white quince, bitters, common butterbur, and plantain grow better. Under conditions with moderate humidity are distinguished - asterisk middle, common plywood, self-seeding poppy, bitter mustard, common butterbur and others. But arid conditions are typical - sticky butterbur, common oats, thistles, talaban field.

The nature and degree of weediness of soybean crops are determined primarily by the potential reserves of seeds and vegetative organs of weed reproduction in the soil, weather conditions in spring and early summer. In the forest-steppe, the main problem weeds in crop crops are pink thistle (Cirsium arvense L.) and yellow (Sonchus arvensis L.), white quince (Chenopodium album L.), field mustard (Sinapis arvensis L.), common butterbur (Amaranthus). retroflexus L.), amaranthus blitoides L., wild radish (Raphanus raphanistrum L.),

odorless chamomile (Matricaria inodora L.), field thistle (Thlaspi arvense L.), field birch (Convolvulus arvensis L.), as well as monocotyledonous (cereal weeds), including chicken millet (Echinochloa crus-galli L.), mouse blue (Setaria glauca L.).

Our research has shown that soybean crops have formed a mixed type of weed, which is dominated by dicotyledonous species of weeds: quinoa white (Chenopodium album L.), butterbur (Amaranthus retroflexus L.), talaban field (Thlaspi arvensis L.), sprats (Poligonum scabrum Moench.), wild radish (Raphanus raphanistrum), pink thistle (Cirsium arvense (L.) Scop.). They differ significantly in biological and morphological features and belong to different botanical families.

Among cereals were present: mouse blue (Setaria glauca (L.) Pal. Beauv.), Chicken millet (Echinochloa cruss-galli (L.) Pal. Beauv.).

Thus, the structure of weed agrocenosis weeding was as follows: there were a total of 102 units/m^2, including cereals - 39 and dicotyledons 63 units/m^2. Among cereal species, blue mouse species dominated - 16 pieces/m^2, chicken millet - 15 pieces/m^2 and oats 6 pieces/m^2. Among the dicotyledonous species of white quince - 16 pcs./m^2, common quince - 14 pcs./m^2, talaban field - 12 pcs./m^2, bitters - 8 pcs./m^2, there were perennial species - thistles 2 pcs./m^2.

Soybeans grow relatively slowly at the beginning of the growing season and weeds compete with them for moisture, nutrients and light. This makes it less competitive than weeds. Yield losses from weeds can range from 30 to 50%. Therefore, integrated weed control is essential for successful soybean cultivation. The critical period for weed control is the phase of 1 to 3 true leaves of the crop. Harmfulness of weeds to soybeans depends on their species composition, moisture conditions, early maturity of the variety, sowing power, potential weediness of the arable layer, techniques and methods of care for soybean crops.

Weeds are one of the main factors limiting the production of agricultural products, including soybeans. They reduce crop productivity through competition, allelopathy, serve as a center for the development of pests, pathogens and other pathogens. Weeds complicate the collection and post-harvest processing of grain, which significantly increases the overhead costs of cultivation. Timely and complete release of crops from competition with weeds for living space, light, moisture, nutrients is a key component of obtaining high yields of crops, including soybeans.

The chemical method of weed control in crops is shifted towards reducing the herbicide press on crops and the environment. The appropriateness of the use of herbicides should depend on the level of weediness of crops, the phase of crop development and should vary according to economic thresholds of harmfulness and taking into account the regulated norms of their use.

The importance of herbicides in agriculture has increased due to both increasing the technical efficiency of chemicals and increasing the volume of their use. The level of phytotoxic effects of combined preparations, mixtures and technological combinations caused a significant weakening of weed resistance, which ensured the destruction or deep suppression of weeds (89-94%) in the case of spraying crops. The group of priority and most common herbicides should include: harness, primextra, basis, task, master, estrone, primo, granstar, which, along with purely phytotoxic properties have provided significant technological progress, easy to use formulations, high solubility, low dependence from external factors, a wide range of terms of processing, the increased level of ecological safety [14].

Subject to treatment with herbicides with one active substance or mechanism of action, we obtain a larger number of resistant species that re-form seeds and have increased resistance. With long-term such use, there is a complete replacement of susceptible species with resistant ones.

Soil and post-emergence herbicides are successfully used on soybean crops. The latter have a number of significant advantages. Until recently, soil herbicides were used on soybean crops, providing: a clear field for the period of early crop development; relative cheapness of field cultivation operations; low cost of drugs; saving the use of sprayers.

In this sense, soil herbicides provide farmers with time. However, such herbicides have enough significant disadvantages that reduce the effectiveness of their use. Let's name these shortcomings: dependence on presence of moisture, optimum temperatures, necessity of mechanical earnings in soil; variety of action on different types of soils, due to which it is necessary to conduct a thorough analysis of the soil for the degree of weeding, the amount of humus and organic matter; the possibility of stressful conditions for young crops.

Due to a number of disadvantages of soil herbicides, farmers prefer post-emergence preparations.

The use of post-emergence herbicides over soil has the following advantages: the ability to assess the extent of weeding, which will allow you to choose a drug with high technical efficiency; the use of post-emergence herbicides completely replaces mechanical tillage, which significantly reduces labor costs and reduces the possibility of wind and other types of soil erosion.

When using post-emergence herbicides, it is important to determine the phase of crop development. To this end, an alternate list of operations was developed: to establish the time of emergence of weeds and stages of crop development; determine the types of weeds and their number at the time of application; reduce the width of soybean rows, which will reduce the competitiveness of weeds.

The degree of crop contamination and harmfulness in our experiments was high. Phytocenosis of weeds in soybean crops due to high competitiveness absorbed much of the productive moisture and nutrients from the soil. Therefore, any methods against weeds can be safely attributed to the most effective measures to regulate water and nutrient regimes and in general the potential of soil fertility.

During the research, soybean crops accounted for 98-102 pieces/m^2 of weed plants, 38% of the total number were perennial cereal weeds, namely: mouse blue, common plaice, chicken millet.

The other part was occupied by dicotyledonous weeds: odorless chamomile, white quince, common buckthorn, bitter gourd. From soil herbicides, we investigated the effect of the drug Frontier® Optima, which was applied to soybean crops at a rate of 1,0 l/ha. Studies have shown high herbicide and cost-effectiveness of the drug Frontier® Optima. Thirty days after the application of Frontier® Optima herbicide, the normal consumption rate of 1,0 l/ha in soybean crops was only 11 pieces/m^2 of weed plants. Cereal weeds were completely absent, only stable dicotyledons remained, in particular quinoa, bitters. This amount of weed vegetation is 79% lower compared to the weed control version, where no herbicides were applied. The efficiency of destruction of annual dicotyledonous and cereal weeds 60 days after application of Frontier® Optima was 75% compared to the control. Before harvesting, the weediness of soybean crops increased slightly and was in the range of 26 pcs/m^2. This figure is 72% lower compared to weeds in the control version, where at the time of harvest there were 94 pieces/m^2 of weed plants (Table 1).

The greatest damage is caused by weeds that appear before or at the same time as soybean seedlings. Due to its biological characteristics, soybeans can not compete with such plants. They should be destroyed no later than 25 days after emergence. Delay in destruction measures reduces the yield by 10% every day. These losses can no longer be offset by any other crop care measures at later stages of soybean growth and development. In areas where weeds were not weeded before soybean harvest, soybean seed yield losses were 64%.

The application of Frontier® Optima herbicide helped to reduce both annual cereals and some dicotyledonous weeds. From the results of research it can be concluded that the application of soil herbicide Frontier® Optima reliably protects soybean crops during most of the growing season.

Since the degree of contamination of agrophytocenoses in the farm was quite high, especially dicotyledonous weeds, we decided in addition to the soil herbicide Frontier® Optima, to apply additional post-emergence herbicide Corum pk, 1,5 l/ha + surfactant Metholate, 10, l/ha.

There are two sides to a plant protection system: the object of protection and the pest, and the difficulty is that they respond differently to climate change.

Table 1

Influence of herbicides on weed infestation of soybean agrocenosis (average for 2019-2020)

Options	Technological type of herbicide	Accounting	Weed rates	
			Quantity, pcs/m^2	Reduction of % to control
Control (without processing)	--	1	102	--
		2	96	--
		3	94	--
Frontier® Optima k.e., 1,0 l/ha	soil	1	21	79
		2	24	75
		3	26	72
Corum p. K., 1,5 l/ha + South Africa Metholate, 1,0 l/ha	insurance	1	102	-
		2	11	89
		3	7	93
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha	soil + insurance	1	20	80
		2	3	97
		3	1	99
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha + Quantum - Molybdenum Chelate (Mo), 0,5 l/ha	soil + insurance + microfertilizer	1	19	81
		2	2	98
		3	1	99

For example: soy is difficult to cope with stressful conditions, reduces yields and resistance to disease. Pests, on the contrary, become more aggressive, diseases affect it more and more often, pests pass their development cycle faster, give more generations, and so on. Weeds do not lag behind when living in their territory, they are better adapted to temperature fluctuations and lack of moisture. One of the trends of the last few years in the protection of soybeans has been to reduce the effectiveness of herbicides. Today, few soybeans do without two treatments against dicotyledonous weeds.

The application rate of Korum® herbicide is from 1,25 to 2,0 l/ha, depending on how difficult the situation is in the field. Corum® should be used in a tank mixture with surfactant Metholate in a ratio of 2:1 - for two units of Corum® should be added one unit of Metholate. The consumption rate of the working solution is 200-250 l/ha. Metholate is a drug that opens the entrance to the internal systems of quinoa, allowing the active components of the product Corum® to effectively destroy it.

Metolats contains substances that reduce the surface tension of the working solution, allowing it to adhere firmly to the sheet. Another feature of Metolate is its ability to dissolve wax and facilitate the penetration of the active ingredients of the herbicide into the leaf. The combination of the special formulation Corum® with surfactant Metholate has a high buffering capacity, which allows you to keep the pH of the solution within optimal limits sufficient to dissolve cuticular waxes and

penetrate into the tissues of the leaf Corum® effectively fights not only white quinoa, it has a very wide range of controlled weeds, including such malicious as ragweed, species of birch, birch, bitters, poppy, yellow and garden thistle, chamomile, cruciferous bur ' and dozens of less common species.

It should be noted that many weeds are able to grow after exposure to the herbicide, so you should act not only effectively but also quickly to prevent them from doing so. The unique combination of the active ingredients of the herbicide Korum® with highly effective surfactant Metholate allows you to completely destroy weeds in 5-7 days.

Due to the high selectivity and soft action, the Corum® application window is very wide - from one to five trifoliate leaves. But the main factor is not the phase of crop development, but the phase of weed development, and we should focus on the most problematic weeds. Dozens of studies across Europe have shown that even a double dose of Corum®, administered with or without Metholate, did not reduce yields. So soybean and pea crops will be safe even on the floors. Keep in mind that imazamox, which is contained in the herbicide Corum®, is part of the Clearfield® system, the products of which should not be used more than once every three years. Care should also be taken to organize crop rotation, as some crops, such as sugar beets and vegetables, may be sensitive to imazamox residues in the soil. Other crops, such as cereals, sunflower and corn, can be sown without restrictions.

According to prof. O.O. Ivashchenko, the sensitivity of white quince to the action of herbicides in the cotyledon phase reaches more than 99%, and in phase 4 pairs of true leaves only 38,5%. That is why the recommendations for the use of Corum® on soybean and pea crops should be divided into two parts [5].

The first crop in the early stages of development, weeds are not overgrown (in the cotyledon phase - the first pair of true leaves). For such conditions the norm of Corum® 1,5 l/hectare + surfactant Metholate of 0,75 l/hectare will be sufficient. The second - problem weeds, in particular quinoa, overgrow (3 pairs of leaves - the beginning of branching). In this case, the maximum rate of Corum® 2,0 l/ha + surfactant Metholate 1,0 l/ha should be applied.

BASF monitors trends in the plant protection market around the world. The group's specialists respond quickly to the urgent needs of agricultural producers, implementing new solutions and helping to make agricultural production more stable and efficient. The new powerful herbicide Corum® is another tool in the agronomist's arsenal to achieve new soybean yield records.

Numerous studies have established the high efficiency of application of post-emergence drugs on soybean crops. Weed mortality reaches 90% or more with a significant reduction in their raw weight, which has a positive effect on crop development, provides high yields of soybeans. According to the recommendations of I. Storchous, it is necessary to take into account the aftereffects of herbicides on subsequent crop rotations. In view of this, selective herbicides should be used, with a shorter detoxification period in the soil and with a more effective effect on different types of weeds [11].

Our studies showed that the herbicide Korum® 1,5 l/ha, which is used in the experiment, significantly reduced the weediness of soybean crops compared to growing without herbicides and manual weeding. Korum® herbicide 1,5 l/ha was applied to phase 5 of trifoliate soybean leaves (early phases of weed growth). After applying the herbicide for a week was dry cool weather. Weed accounting has shown that when using the drug on vegetative plants, its phytotoxicity depends to a lesser extent on the species composition of weeds.

Accounting conducted 30 days after spraying the crops showed that the effectiveness of Corum® 1,5 l/ha against the weed complex in soybean crops was 89% compared to the original weed.

This drug effectively destroyed cereal weeds (92-97%). The total number of weeds decreased at the time of harvest by 93% compared to the original, which proves the high efficiency of the drug to eliminate weeds in soybean crops (Table 2).

The development of highly effective weed protection systems depends largely on the completeness of the study of weed crops, ie identifying the composition of weeds in different crops with the analysis of the groups they form and the correctness of the generalization of the results.

Given the agri-environmental requirements and the high level of weed infestation of many weed species, it is almost impossible to destroy them in soybean crops with a single herbicide. Therefore, the fight against them must be carried out comprehensively, in a combination of agronomic and chemical measures, both on the predecessors in crop rotation and during the main and pre-sowing tillage. When soybeans are sown, weeds have a negative effect, which in various ways contribute to the reduction of crop productivity. The losses are mainly due to competition between weeds and cultivated plants. Weeds not only reduce the yield of the main crop, but also degrade its quality. The change in quality indicators in weedy fields is due primarily to the fact that weeds remove from the soil the most valuable nutrients, use largely groundwater, affect the properties soil. Selective herbicides do not show a negative effect on crops to which selectivity is directed and do not worsen the quality of the crop, provided that the regulations of their application are strictly observed.

Table 2

The effect of herbicides on the main species of weeds soybean agrocenosis (average for 2019-2020)

Options	Acc-ount.	Cereal weeds		Loboda is white		Shchyrytsia ordinary	
		pcs/m^2	Decrease in% to con-trol	pcs/m^2	Decrease in% to con-trol	pcs/m^2	Decrease in% to con-trol
Control (without processing)	1.	36	-	16	-	14	-
	2.	32	-	16	-	14	-
	3.	31	-	16	-	14	-
Frontier® Optima k.e., 1,0 l/ha	1.	1	97	9	44	8	43
	2.	2	94	9	44	8	43
	3.	2	94	9	44	8	43
Corum p. K., 1,5 l/ha + South Africa Metholate, 1,0 l/ha	1.	36	-	16	-	14	-
	2.	3	92	3	81	2	86
	3.	1	97	2	88	1	93
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha	1.	1	97	9	44	6	57
	2.	-	100	1	94	1	93
	3.	-	100	1	94	1	93
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha + Quantum - Molybdenum Chelate (Mo), 0,5 l/ha	1.	1	97	9	44	6	57
	2.	-	100	1	94	1	93
	3.	-	100	1	94	-	100

The effectiveness of the combined use of soil and post-emergence drugs in our experiment was quite high. Thus, the accounting was carried out after the use of the soil preparation Frontier® Optima k.e. showed that its use reduced weed infestation by cereal weeds by 94% compared to controls. After application of the herbicide Corum + surfactant Metholate, the number of cereal weeds in soybean crops decreased to 1 piece/m^2, which is 97% less than the original. The use of this method of weed control has allowed to get rid of them almost completely - in soybean crops at harvest time. The combination of pre-emergence and post-emergence use of the studied drugs had a greater phytotoxic effect on the main weed species in soybean crops. Thus, cereal weeds were destroyed by 100%, butterbur by 93%, and quince by 94%. It should be noted in areas where the composition was introduced Frontier® Optima k.e. + Corum pk + South Africa Metholate + Quantum - Chelate Molybdenum phytotoxic effect on weeds increased, and soybean plants later grew and developed better. The rates of weed control in soybean crops compared to control plots for the period of soybean seed harvest were 94-100% (Table 2).

The level of soybean seed yield and its stability largely depend on extreme environmental factors. In our experiments, a significant increase in soybean seed yield was obtained with the application of soil and post-emergence herbicides. Selective herbicides kill and inhibit weed growth, which improves the growth and development of the crop.

The yield of soybean seeds, where herbicides were applied in comparison with the control was on average: when using the herbicide Frontier® Optima k.e., 1,0 l/ha – 2,09 t/ha, Corum p. к., 1,5 l/ha + surfactant Metholate, 1,0 l/ha - respectively 2,57 t/ha., and when applying Frontier® Optima k.e. + Corum p. к. + South Africa Metholate – 2,78 t/ha. As can be seen from the above data, the highest soybean yield was in the variant with the application of soil herbicide Frontier® Optima k.e., 1,0 l/ha – 2,09 t/ha, Korum p. к., 1,5 l/ha + South Africa Metholate, 1,0 l/ha + Quantum - Molybdenum Chelate (Mo), 0,5 l/ha - the level of soybean seed yield was on average over two years – 2,94 t/ha, which is more than in control areas on 1,92 t/ha or 188% (Table 3).

Therefore, these drugs are quite effective in soybean crops, as they increase yields and reduce weeds.

Table 3

Soybean yields depend on exposure herbicides and microfertilizers, t/ha

Options	Seed yield, t / ha			Increase in control	
	2019	2020	aver-age	t/ha	+/-
Control (without processing)	1,21	0,82	1,02	-	-
Frontier® Optima k.e., 1,0 l/ha	2,52	1,65	2,09	+ 1,07	105
Corum p. K., 1,5 l/ha + South Africa Metholate, 1,0 l/ha	3,06	2,08	2,57	+ 1,55	152
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha	3,20	2,35	2,78	+ 1,76	173
Frontier® Optima k.e., 1,0 l/ha + Corum p.k., 1,5 l/ha + surfactant Metholate, 1,0 l/ha + Quantum - Molybdenum Chelate (Mo), 0,5 l/ha	3,34	2,54	2,94	+ 1,92	88
NIR_{05}	0,17 0,18				

Thus, in order to maintain and increase the yield of soybean seeds, it is important to eliminate all possible causes of its loss. Among the main reasons for the loss of soybean seed yield is the negative effect of weediness of agrocenoses, which is not only to reduce the seed yield but also to deteriorate its quality. Therefore, for the successful cultivation of soybeans in technological measures, much attention should be paid to the introduction of herbicides and their compositions.

Conclusions

1. The structure of weeding of soybean agrocenosis was as follows: there were a total of 102 units/m^2, among them cereals - 39 and dicotyledons 63 units/m^2. Among cereal species, blue mouse species dominated - 16 pieces/m^2, chicken millet - 15 pieces/m^2 and oats 6 pieces/m^2. Among the dicotyledonous species of white quince - 16 pcs./m^2, common quince - 14 pcs./m^2, talaban field - 12 pcs./m^2, bitters - 8 pcs./m^2, there were perennial species - thistles 2 pcs./m^2.

2. The efficiency of destruction of annual dicotyledonous and cereal weeds 60 days after application of Frontier® Optima was 75% compared to the control. Before harvesting, the weediness of soybean crops increased slightly and was in the range of 26 pcs/m^2. This figure is 72% lower compared to weeds in the control version, where at the time of harvest there were 94 pieces/m^2 of weed plants.

3. Accounting conducted 30 days after spraying the crops showed that the effectiveness of Korum® 1,5 l/ha against the weed complex in soybean crops was 89% compared to the original weed. This drug effectively destroyed cereal weeds (92-97%). The total number of weeds decreased by 93% at harvest time compared to the original, which proves the high effectiveness of the drug to eliminate weeds in soybean crops.

4. The combination of pre-emergence and post-emergence application of the studied drugs had a greater phytotoxic effect on the main weed species in soybean crops. Thus, cereal weeds were destroyed by 100%, butterbur by 93%, and quince by 94%. It should be noted in areas where the composition was introduced Frontier® Optima k.e. + Corum pk + South Africa Metholate + Quantum - Chelate Molybdenum phytotoxic effect on weeds increased, and soybean plants later grew and developed better. Weed control rates for soybean weeds were 94-100% compared to control plots during the soybean harvest period.

5. The highest soybean yield was in the variant with the application of soil herbicide Frontier® Optima k.e., 1,0 l/ha – 2,09 t/ha, Corum p. к., 1,5 l/ha + surfactant Metholate, 1,0 l/ha + Quantum - Molybdenum Chelate (Mo), 0,5 l/ha - the level of soybean seed yield averaged 2,94 t/ha over two years, which is 1,92 more than in the control plots t/ha or 188%.

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