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THE EFFECT OF HERBICIDES AND GROWTH REGULATOR ON THE YIELD OF WINTER RAPESEED

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The article summarizes the results of research on weed control with soil and insurance herbicides, as well as evaluates the influence of the growth regulator Noostim on the formation of the winter rapeseed crop hybrid Dalton. We researched the species of weeds and evaluated the ecological and biological effectiveness of herbicides. The weeding structure of the agrocenosis of winter rape is presented as follows: on average there were 53 plants/m^2, among which the presence of monocots was 14 plants/m^2 and dicots 39 plants/m^2. Therefore, it was established that the type of weediness is mixed, and the degree is medium.

The drugs studied in the experiment did not inhibit winter rape plants and liquefaction of crop density was not observed. Treatment of rapeseed crops with Noostim was important for regulating the development of cultivated plants, reducing the risks of stress from pesticide load, ensuring control of the most common diseases and contributing to increased yields. Typhoon herbicide treatment (2.0 l / ha) reduced weeds by 79% compared to controls.

Only cereal weeds remained after the application of the insurance herbicide Slash (1.0 l / ha). Higher height of winter rape plants and better branching ensured an increase in yield with consistent application of herbicides. Statistical evaluation of the obtained data confirms that the introduction of herbicides reduced the number and harmfulness of weeds, which significantly affected the growth of yield. The largest number of winter rapeseed seeds was obtained during 2 years of research on the variant, where the herbicides Typhoon (1.6 l/ha) and Slash (0.75 l/ha) were applied sequentially with reduced from the recommended rates of use together with the growth regulator Noostim (0, 3 l/ha). The oil content in winter rapeseed increased to 46.4-46.7%, and the oil yield was 1.57-1.94 t ha^{-1} as a result of reducing the level of weed vegetation due to the application of herbicides.

Key words: *winter rapeseed, weeds, herbicides, growth regulator, yield.*
Table 4. Lit. 18.

Introduction. Rapeseed is an extremely valuable technical, fodder, and honey crop. Its seeds contain from 48 to 52% of oil, it is widely used in food, paint, and soap industries. It is also used as a raw material for biodiesel. The heat-treated oilcake is used for animal feed. Nowadays, rapeseed is an investment-attractive crop for Ukrainian farmers. According to state statistics, 4,937,000 tons of winter rapeseed were harvested in our country in 2021. In Ukraine sown areas of winter weed were reduced from 1242.8 thousand hectares to 883.4 thousand hectares in the last three years (2019-2021). The average yield for varied from 1.99 t ha^{-1} to 2.11 t ha^{-1}.

Rape is particularly sensitive to the adverse effects of weeds in the first 10-20 days of its vegetation, that's why the agrophytocenosis should be clean of unwanted vegetation during this period. Weeds in winter rapeseed suppress it and reduce its yields. Weeds also have a negative effect on the winter hardiness of rapeseed because

they impair plant development and sugar accumulation by preventing them from overwintering successfully. Spraying active vegetative weeds gives the best results of the herbicides application to protect rapeseed. It is important that they have a relatively large leaf area for faster absorption of the working solution. However, weeds should not be allowed to overgrow as they will require a higher herbicide consumption to kill them.

Therefore, the effective weed control system development in the winter rapeseed agrophytocenosis by herbicides application is an important element of its cultivation technology.

The **aim of the research** is to substantiate the soil and post-emergence herbicides application for weed control in winter rapeseed agrocenoses, and to evaluate the impact of the growth regulator Noostim on rapeseed development.

Analysis of recent research and publications. Rapeseed has strengthened its competitive position in the world market over the last decade as the gross harvest of its seeds has grown significantly and markets have expanded. Today, rapeseed ranks 3rd position among oilseeds after sunflower and soybeans in terms of sown areas [10, 15].

The main reasons for the low yield of winter rape are ineffective control of harmful organisms and unstable overwintering of cultivated plants.

It was established that an increase in the volume of biomass growing of energy crops for the further integrated processing and production of biofuels, in particular biodiesel, should be made taking into account the situation both with existing needs in food products and with available sources of supply with fossil energy resources. Based on the calculations, it has been established that the current biodiesel production process in Ukraine will be economically advantageous from rape and sunflower seeds and economically unprofitable from soybean seeds, under the current price policy for oilseeds (rapeseed, sunflower, soybean) and petroleum diesel.

Production of the finished bioenergy product for consumption is characterized by greater economic benefits than the massive export of raw materials. Available in the country's agro-industrial complex the powerful potential of the scientific-technical and industrial base for the cultivation of biomass of oilseeds provides the biofuel industry with high economic efficiency, which gives grounds to distinguish it into a separate competitive renewable energy industry [7].

The inclusion of oilseed rape in the crop rotation is very important because it is characterized by good phytosanitary properties.

Crop culture (optimal sowing time, quality seedbed preparation, and productive stem density), time of rapeseed and weed germination, their species composition affect the competitiveness of rapeseed to weeds. The average loss of rapeseed yield due to weeds is 15% or more. This problem is especially acute on liquefied crops, in unfavorable soil conditions or dry weather after sowing, weed losses can be much higher and reach 30-60% in such fields [4, 6].

Weed populations are almost ubiquitous in agrophytocenoses, forming their species composition and number of individual weed species for each field; their seeds and organs of vegetative reproduction are also a potential reserve in the soil [5, 6].

Thus, we need to sow crop in the field without weeds, it can be achieved by the soil herbicides application. Soil application of Dual Gold herbicide is a highly effective and time-tested method. This herbicide is the least phytotoxic to crops. Phytotoxicity the chloroacetamide group can be obderved in delayed germination for 3 weeks. Dual Gold is used with seed preparations in the combined system of crop protection. The herbicide weakens germinated weed plants enhancing the effectiveness of seed herbicides and expanding the range of their protective action [3].

Negative effects of weeds can be seen in the reduction of vegetative mass of rapeseed, the number of productive branches and pods per plant, and the weight of 1,000 seeds. The farm receives higher income from increased yields and reduced drying and cleaning costs through timely weed control [5].

Rapeseed will grow faster in weeds. Therefore, autumn weeding of crops causing excessive growth and extraction of plants leads to the removal of the growth point above the soil surface and poor development of the root system, which generally increases the freezing risk and causes the formation of low-yield crops [12, 13, 14].

Autumn cultivation of winter rapeseed includes a set of measures that create optimal conditions for plant growth and development, provide weed control, protection from diseases, and pests. It is advisable to carry out pre-emergence harrowing in clogged fields with the emergence of weed seedlings in 3-4 days after rape sowing. Then, weeds can also be destroyed by post-harrowing of crops, it should be done not earlier than in the phase of 3-5 true leaves in rapeseed [11].

It is recommended to treat winter and spring rapeseed crops with growth regulators in the spring budding phase to reduce stem length and prevent lodging of tall varieties and hybrids, stimulate the formation of additional lateral shoots, and prevent a number of fungal diseases. The optimal time for the introduction of retardants in the spring is at a plant height of 30 cm and before budding on the main shoot. As a result, the leaf surface area of rapeseed is increased, the flowering period of the crop is reduced, and the stress from pesticide treatment is reduced [2].

The Clearfield® herbicide system in oilseed rape can achieve similar grain yields as a more common, pre-emergence herbicide system. With larger row spacing or lower tillage intensity, higher weed pressure may be expected when using the Clearfield® system. However, this does not necessarily have a negative effect on grain yield. Reduced effects of the Clearfield® system on grasses or volunteer cereals can be countered in agricultural practice with the additional application of a graminicide. The Clearfield® system expands farmers' options for chemical weed control in oilseed rape [18].

The lowest values of total energy costs are for seeds (4%), live labor (3%), and pesticides (2%) in the technology of growing winter oilseed rape [9].

Rapeseed is particularly sensitive to the negative effects of pests that can cause a shortage of seed yields, i.e., pests (30-40 %), diseases (30-80 %), and weeds (20-30%). On average, the liquidity of these losses is provided at 60%. Thus, the production of rapeseed can be increased by at least 25-50% by intensifying plant protection [1].

Restricting weeds due to the chemical pesticides application is effective if herbicides have been selected correctly and application recommendations have been followed. It will ensure the maximum impact on the harmful object and the minimum one on the environment. The choice of herbicides for controlling segetal vegetation in winter rapeseed crops is relatively limited compared to such crops as wheat or maize. Herbicides used to control broadleaf weeds can have a negative effect on the crop. Soil herbicides control a narrow range of weeds, and post-weed herbicides are more effective but do not provide maximum control of cruciferous weeds, and their seeds mixed with rapeseed reduce the quality of the crop. It is necessary to carry out two and sometimes three spraying of crops to obtain the maximum limitation of weed damage during the growing season [12].

In many countries and in Ukraine, science and practice have sought ways to increase yields and quality of crops, reduce the negative impact of toxic substances on agricultural systems and one of the areas was the use of plant growth regulators based on humic acids, in technologies of cultivation of agricultural crops. Studies have shown that pre-sowing treatment of winter rape seeds by single and double spraying of plants during the growing season at different seeding rates significantly improved the photosynthetic and seed productivity of winter rape. The highest yield of winter rape hybrid Mercedes-4.13 t ha^{-1} (+0.61 t ha^{-1} compared to the control) on average over the years of research was obtained in the variant of pre-sowing treatment of winter rape with growth regulator "Vermiyodis" at a dose of 5 l/t, seeding rates of 0.6 million/ha of sprouting seeds and double spraying of plants during the growing season with the growth regulator "Vermiyodis" at a dose of 4 l/ha [16].

Oil and protein are known to accumulate in rapeseed from fertilization to full maturity, and seed storage substances such as lipids, starch, and protein are formed from carbohydrates synthesized by photosynthesis in green parts of plants from carbon dioxide and water. The sowing period and the fertilizer system have a significant impact on the formation of quality indicators of seeds of winter rapeseed hybrids [8, 17].

Materials and methods of research. The research was conducted in the research field of Vinnytsia National Agrarian University. Weed species in winter rapeseed agrocenoses were researched; the ecological and biological effectiveness of herbicides and their impact on crop yields were evaluated.

The soils of the experimental area are gray forest podzolic, they are characterized by such agrochemical indicators as 2.16% humus content in the arable layer (according to Tiurin), 5.8 pH of the salt extract; hydrolytic acidity is 2.3-2.7 mg per 100 g of soil, the amount of absorbed bases is 15 mg per 100 g of

soil, the degree of alkali saturation is 79-88%. The soils contain for plants 81-89 mg of available nitrogen per 1 kg of soil (according to Cornfield), 205-251 mg of mobile phosphorus per 1 kg of soil and 83-90 mg of exchangeable potassium per 1 kg of soil (according to Chyrykov).

The soil, its agrochemical parameters, hydrothermal conditions are typical for this area and suitable for growing winter rapeseed.

We grew a mid-late hybrid Dalton. It is characterized by good winter hardiness and resistance to lodging (6 points), excellent drought resistance (9 points). Resistance to diseases, in particular to phomosis is also high (9 points). It is recommended for growing in the Forest-Steppe zone, has a strong root system and is resistant to shedding.

Rapeseed was sown on August 15. The predecessor of rapeseed was winter wheat. Depth of sowing seeds was 3-4 cm with a sowing rate of 3.8 kg per ha. $N_{120}P_{90}K_{120}$ (phosphorus-potassium fertilizers) were applied to the main tillage, and nitrogen was applied in 3 steps, i.e., under pre-sowing cultivation, in the spring on frozen-thawed soil and at the beginning of stalking. Nuredin Super (0.75 l / ha) was applied to control the number of phytophages. Architect (2.0 l / ha) was used against the spread of diseases in the rapeseed agrophytocenosis.

Winter rapeseed weed accounting was performed by the quantitative-weight method. According to this method, we have identified permanent accounting plots of a certain size in the research areas. The number of weeds was counted at all times. Weeds were sorted by species; the number of stems was recorded. The condition of plants in the herbicide-treated areas was monitored during the growing season. Signs of damage and weed death were noted.

Timing depends on the method of the herbicides application, their action and research objectives. Studying soil herbicides we conducted three weed surveys, i.e., the first survey was conducted in 30 days after treatment, the second survey was conducted in 40-60 days and the third survey was conducted before harvest. Researching used herbicides on vegetative crops and weeds, three records were also conducted, i.e., the first one was conducted before application (initial weeding), the second one was conducted in 20-30 days and the third one was conducted before harvest.

We researched the effect of herbicides on seedlings, plant density, timing of growth and development, and harvest structure. Harvest accounting was performed on each plot separately. The size of the accounting area was 20 m^2, the recurrence was three times.

In the experiment, we applied 2 l / ha of soil herbicide Typhoon (Metolachlor 960 g / l). Its active ingredient is characterized by high herbicidal properties on annual cereals and some dicotyledonous weeds. Metolachlor acts on germinating weeds, penetrates the tissues of spikes, actively inhibits cell division due to disorders of lipid metabolism.

When applying the herbicide, the soil should be moist and fine-grained structure. It must be treated with light harrows after application. It is expedient to

carry out rolling for its consolidation in case of the soil drying.

The herbicide has certain advantages:

- lack of phytotoxicity during precipitation (precipitation of 10-20 mm increases its effect, more evenly distributing it in the soil);
- the possibility of combining its introduction with other technological operations, i.e., sowing, cultivation, harrowing and others;
- affects the root system and seedlings of weeds.

We used Slash Herbicide at a rate of 1.0 l / ha to protect rapeseed from weeds. It is a selective post-emergence herbicide with a broad spectrum of action, developed on the basis of the latest ArylexTM active molecule for spring use in winter rapeseed crops. We applied it from the beginning of stem growth to flower buds.

Advantages of this herbicide:

- high control of a wide range of annual and perennial deciduous weeds;
- has both leaf and partially soil activity;
- compatible with most plant protection products used in winter rapeseed crops;
- can significantly suppress annual dicotyledonous cruciferous weeds.

We also applied Noostim at a rate of 0.3 l / ha on winter rapeseed crops. It is a growth regulator with a cryoprotective effect.

Mathematical processing of research data was performed on a personal computer with a set of programs such as Sigma.

Research results. Weed management is extremely important for sustainable crop production in all cropping systems. Management strategies should be devised to control weed during the critical competition period.

Weed populations are almost ubiquitous in agrophytocenoses, forming their species composition and number of individual weed species for each field; their seeds and organs of vegetative reproduction are also a potential reserve in the soil (Ivashchenko et al., 2018; Ivashchenko and Ivashchenko, 2019). More than 50 species of weeds occur in winter rapeseed, about 20 of which are the most common. The most common species are such annual spring weeds (sticky willy (*Galium aparine L.*), lamb's quarters (*Chenopodium album L.*), wild buckwheat (*Polygonum convolulus L.*), field mustard (*Sinapis arvensis L.*), potato weed (*Galinsoga parviflora*), common amaranth (*Amaranthus retroflexus L*), wintering species (shepherd's purse (*Capsella bursa pastoris*), scentless false mayweed (*Matricaria perforata*), Canadian horseweed (*Erigeron canadensis L.*), common stork's-bill (*Erodium cicutarium L.*), perennial weeds (field bindweed (*Convolvulus arvensis L.*), field milk thistle (*Sonchus arvensis L.*), creeping thistle (*Cirsium arvense L.*), creeping buttercup (*Ranunculus repens*), dandelion (*Taraxacum officinale*), and sometimes common horsetail (*Equisetum arvense L.*) on acidic soils), and ephemerals (chickweed (*Stellaria media L.*) and annual meadow grass (*Poa annua L.*).

The highsum of precipitation promoted the development of the weed species.

Weed species in winter rapeseed depend on weather and soil conditions. They also vary depending on the chosen protection tactics and strategy, the set of

herbicides used on previous crop rotations, tillage, and so on. Weeds are easier to control in autumn, in the early stages of their growth and development, when they are most sensitive to the active ingredients of herbicides than in spring, when most of them overwintered, formed strong rosettes or flared and became more resistant to drugs.

In recent years, the most common weeds in winter rapeseed crops are winter weeds, their biological development is similar to crops. The fall of cereals predominates among the contaminants.

The largest range of weeds is controlled before the seedlings of cultural plants.Weed agrocenosis of winter rapeseed is as follows: on average there were 53 pcs per m^2, i.e., monocotyledons were 14 pcs per m^2 and dicotyledons were 39 pcs per m^2. Winter wheat felling dominated by 5 pcs per m^2 and pigeon grass 5 pcs per m^2 among cereal species. The most common species were Canadian horseweed (9 pcs per m^2) and the common stork's-bill (8 pcs per m^2) among the dicotyledonous species. There were field bindweed and field thistle on average 1 unit per m^2 among the perennial species.

Thus, the type of weed is mixed and the degree is moderate. It is important to note that all regions of Ukraine are also characterized by mixed contamination of winter rapeseed crops with different types of weeds.

Winter rapeseed is a crop that is highly competitive against weeds. At the beginning of its growing season and in the spring, it is vulnerable to their negative effects. For effective weed control the use of integrated weed management strategies are essential across the weed lifecycle including preventing seed return, depleting seed banks, effectively removing weed seedlings, stopping seed set and good on farm hygiene.

In the control variant, the number of weeds during the winter rapeseed growing season was reduced from 53 pcs / m^2 to 39 pcs / m^2. There were only those species that occupy the lower tier and tolerate shading. They formed neotenic forms so their harmfulness was low.

There are a number of options when treating winter oilseed rape for weeds. Many products have flexible timing and can be applied pre-emergence or early post-emergence. Pre-emergence treatment is generally most cost-effective because at this timing the broadest spectrum of weeds is controlled, and post-emergence treatment generally requires a higher dose.

The rapeseed field is sprayed with soil herbicides before or after sowing, but before the winter rapeseed germination to limit the harmfulness of cereals, autumn weeds and other types of vegetation. Such herbicides provide a safe start for plants.

Rapeseed is a highly profitable crop but requires a lot of attention. Good weed protection is one of the components of a system that promotes the realization of biological potential. Tolerance of competitors is more beneficial than suppression.

In one variant of the experiment, the above-mentioned herbicides were consistently applied at a reduced rate to better control weeds and reduce their harmfulness. Sequential use of herbicides with reduced application rates has the

potential to minimize the use of excessive amounts of herbicides.

The best phytosanitary condition of crops was on the variant of sequential application of pre-emergence and post-emergence herbicides with treatment by plant growth regulator Noostim (0.3 l / ha). An integrated approach will achieve effective control over weeds.

The herbicides researched in the experiment did not inhibit winter oilseed rape and no liquefaction was observed. Weed control is vital to produce high yields of good-quality crops. It also removes competition, reduces harvest difficulties and helps to prevent the spread of pests and diseases.

It is assumed that broad-leaved weeds are less competitive than grass weeds in winter oilseed rape. Typhoon herbicide treatment (2.0 l / ha) reduced weeds by 79% compared to controls. Only cereal weeds remained after application of Slash herbicide (1.0 l / ha) (Table 1).

Table 1

Weediness of winter rapeseed depending on protection measures (average for 2020-2021)

Option of the experiment	Technological type of herbicide	Recording	Weed rates	
			Quantity, pcs / m^2	Reduction to control, %
Control (without treatment)	-	1	53	-
		2	46	-
		3	39	-
Typhoon k.e., 2.0 l / ha	soil	1	11	79
		2	14	70
		3	14	64
Slash k.e., 1.0 l / ha	insurance	1	52	-
		2	9	80
		3	8	79
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha	soil + insurance	1	10	81
		2	4	91
		3	2	95
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha, Noostim, 0.3 l / ha	soil + insurance + PPP	1	9	83
		2	2	96
		3	1	97

The source is formed on the basis of own results of researches

Weed species success was favoured by tolerance to oilseed rape herbicides and germination synchronous with the crop. At the beginning of the growing season, rapeseed grows relatively slowly because it forms a strong root system at this time and it is most vulnerable to weeds. Vegetative mass begins to grow intensively after the stalk stage. The highest yield in rapeseed is on the lower tier, so to get a high yield it is necessary to protect and preserve it as much as possible. Prolongedweed control is the most cost-effective option.

Thickened rapeseed crops are more capable of overgrowth. As a result, the protection of cultivated plants in the frosty period may decrease. In Ukraine, more

than 94% of the total sown area of rapeseed is its winter form. Weather and climatic conditions of our state are favorable for its cultivation. Winter rape is more productive due to the longer growing season. In autumn, there is a gradual hardening of cultivated plants with a gradual decrease in temperature. They can tolerate frosts from minus 10 to minus 15 degrees Celsius in the absence of snow cover.

It is important to know the components of crop yield to determine the influence of researched factors on the winter rapeseed yield. The main structural elements of the winter rapeseed crop are the total number of pods and seeds per plant, the average number of seeds per pod, the weight of 1,000 seeds and the weight of seeds per plant. The maximum seed yield can be formed at the optimal ratio of these indicators. It should be borne in mind that with insufficient development of one structural element, the harvest can be compensated by other indicators.

The application of herbicides and plant growth regulators directly affects the structure elements of the winter rapeseed crop by reducing competition from weeds. Accordingly, winter rape is better consumed by available nutrients and moisture, they are better lit (Table 2).

Table 2

Influence of herbicides and PPPs on elements of winter rapeseed harvest (average for 2020-2021)

Option	Height of plants, cm	Number	
		Pods, pcs / plant	Seeds in a pod, pcs.
Control (without herbicides)	91	84	15
Typhoon k.e., 2.0 l / ha	148	93	16
Slash k.e., 1.0 l / ha	141	92	16
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha	163	96	16
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha, Noostim, 0.3 l / ha	157	99	17

The source is formed on the basis of own results of researches

It is recommended to treat winter rapeseed with growth regulators in the spring, when the plants are budding. It reduces the length of the stem and prevents the lodging of tall varieties and hybrids, stimulates the formation of additional lateral shoots, and prevents a number of fungal diseases.

Rapeseed is characterized by a high need for water. Steming, budding and flowering are the most critical periods for it. The transpiration coefficient of rapeseed is 400-500 mm. Thus, the absence of weeds allows crops to use the available moisture effectively to form higher yields.

Weeds can delay ripening and harvesting. The present study results indicate that the influence on the seed yieldof winter oilseed rape largely depended on the course

of weather conditions. The delay of harvest of rape has a substantial influence on the yield of seeds.

Higher height of winter rape plants and better branching ensured an increase in yield with consistent application of herbicides (Table 3).

Table 3

Influence of herbicides and PPPs on winter rapeseed yield (average for 2020-2021), t ha^{-1}

Option of the experiment	Seed yield			+ control	
	2020	2021	Average	t /ha	%
Control (without herbicides)	2.28	2.51	2.40	-	-
Typhoon k.e., 2.0 l / ha	3.28	3.48	3.38	0.98	40.8
Slash k.e., 1.0 l / ha	3.12	3.39	3.26	0.86	35.8
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha	3.59	3.84	3.72	1.32	55.0
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha, Noostim, 0.3 l / ha	4.07	4.25	4.16	1.76	73.3
LSD_{05}	0.11	0.12			

The source is formed on the basis of own results of researches

The use of regulators of growth of plants decreases the losses of harvest. Weather conditions also had some influence on the formation of winter rapeseed crops. Seed yield significantly depends on the peculiarities of the autumn development of its plants. It will be highest if the plants have 10 leaves at the time of the end of autumn vegetation. Both too early sowing and delays in sowing lead to a decrease in field germination of seeds, which subsequently has a negative impact on yield.

Rapeseed plants well developed in the autumn have the highest yield potential. Regulation of rapeseed growth is focused on delaying weak plants in the vegetative phase of development to form the leaf apparatus before the shoot ejection phase.

In the case of sequential application of herbicides, the growth regulator Noostim was applied. It was important for regulating the development of cultivated plants, reducing the risk of pesticide stress, ensuring control of the most common diseases, and helping to increase yields.

The level of yield is the main parameter determining the efficiency of using certain elements of the technology of growing cultivated plants.

Statistical data confirm that the effect of herbicides on reducing the number and harmfulness of weeds significantly affected yields. The largest amount of winter rapeseed was obtained in 2 years of research on the variant, where the herbicides Typhoon (1.6 l / ha) and Slash (0.75 l / ha) with the growth regulator Noostim (0.3 l/ ha) were applied consistently with reduced consumption rate.

Rapeseed oil is known forits high content of monounsaturated fatty acids and a moderate content of polyunsaturatedfatty acids, contains omega-3 fatty acids. Therefore this the only well-balanced oil amongall the vegetable oils.

Rapeseed must meet certain technical requirements for industrial processing.

According to DSTU 4966:2008, rapeseed of the highest class, i.e., for food purposes, must contain a mass fraction of erucic acid in the oil of not more than 1.5% and not more than 20.0 μmol / g glucosinolates (these are harmful sulfur-containing substances that may cause growth retardation and reduced live weight gain of domestic animals).

Table 4

Influence of herbicides and PPP on fat output and biochemical parameters of winter rapeseed (average for 2020-2021)

Option	Oil content,%	Oil output, t ha^{-1}	Glucosinolates, μmol / g
Control (without herbicides)	45.1	1.08	14.7
Typhoon k.e., 2.0 l / ha	46.4	1.57	12.8
Slash k.e., 1.0 l / ha	46.5	1.52	12.7
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha	46.6	1.73	12.9
Typhoon k.e., 1.6 l / ha, Slash k.e., 0.75 l / ha, Noostim, 0.3 l / ha	46.7	1.94	12.9

The source is formed on the basis of own results of researches

The oil content of winter rapeseed was at the level of 45.1%, the oil yield was 1.08 t ha^{-1}, the content of glucosinolates was 14.7 μmol / g in the control areas. The results of the analysis of the effect of herbicides and plant growth regulator on fat yield and biochemical parameters of winter rapeseed showed that the oil content in winter rapeseed increased and amounted to 46.4-46.7%, oil yield 1.57 -1.94 t ha^{-1} as a result of reducing the presence of weeds. Thus, we can conclude that the application of herbicides and plant growth regulators improve the quality of winter rapeseed.

Conclusion. The best yields of winter rapeseed were obtained in areas where the soil herbicide Typhoon (1.6 l / ha) and the insurance herbicide Slash (0.75 l / ha) with PPP Noostim (0.3 l / ha) were used. The yield of winter rapeseed was at the level of 4.16 t ha^{-1}, in comparison with the control plots, the increase in yield was 1.76 t ha^{-1}, or 73.3%. As a result of reducing the negative impact of weeds on the crop with the application of herbicides, the oil content in winter rapeseed increased and amounted to 46.6-46.7%, oil yield 1.57-1.94 t ha^{-1}.

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АНОТАЦІЯ
ВПЛИВ ГЕРБІЦИДІВ І РЕГУЛЯТОРА РОСТУ НА УРОЖАЙНІСТЬ ОЗИМОГО РІПАКУ

У статті узагальнено результати досліджень боротьби з бур'янами ґрунтовим та страховим гербіцидами, а також оцінено вплив регулятора росту Ноостим на формування врожаю ріпаку озимого гібриду Далтон. Досліджено види бур'янів, оцінено еколого-біологічну ефективність гербіцидів. Структура забур'яненості агроценозу ріпаку озимого представлена таким чином: у середньому було 53 рослини/м^2, серед яких наявність однодольних – 14 рослин/м^2 та дводольних – 39 рослин/м^2. Тому було встановлено, що тип забур'яненості посівів ріпаку озимого є змішаний, а ступінь – середня. Досліджувані в експерименті препарати не пригнічували рослини ріпаку озимого і зрідження густоти його посівів не спостерігалося. Обробка посівів ріпаку препаратом Ноостим мала важливе значення для регулювання розвитку культурних рослин, зниження ризиків стресу від пестицидного навантаження, забезпечення контролю найпоширеніших хвороб і сприяла

підвищенню врожайності. Обробка гербіцидом Тайфун (2,0 л/га) зменшила забур'яненість на 79 % порівняно з контролем. Після внесення страхового гербіциду Слеш (1,0 л/га) залишилися лише злакові бур'яни. Більша висота рослин озимого ріпаку та краще розгалуження забезпечили підвищення врожайності при послідовному застосуванні грунтового та страхового гербіцидів. Статистична оцінка отриманих даних підтверджує, що внесення гербіцидів зменшило чисельність та шкодочинність бур'янів, що суттєво вплинуло на зростання врожайності. Найбільшу кількість насіння озимого ріпаку отримано за 2 роки досліджень на варіанті, де гербіциди Тайфун (1,6 л/га) та Слеш (0,75 л/га) застосовували послідовно із зниженими від рекомендованих норм використання разом із регулятором росту Ноостим (0,3 л/га). Вміст олії в насінні озимого ріпаку підвищився до 46,4-46,7%, а вихід олії становив 1,57-1,94 т/га через зниження рівня забур'яненості внаслідок застосування гербіцидів.

Ключові слова: *озимий ріпак, бур'яни, гербіциди, регулятор росту, урожайність.*

Табл. 4. Літ. 18.

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