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Environmental and health issues population at application of cotton defoliant «NitroDEF» in agriculture

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Abstract. The toxicological characteristics of the "NitroDEF" defoliant preparation were investigated. The hygienic standards of the drug in environmental objects have been scientifically substantiated. Based on the studies carried out, the permissible daily dose (PDD) for a person at the level of 1.8 mg/person/day was calculated and scientifically substantiated. Recommended: maximum permissible concentration (MPC) in the water of reservoirs - 3.0 mg/l; the maximum permissible concentration (MPC) of the drug in the air of the working area at the level of 3.0 mg/m^3, the maximum permissible concentration (MPC) in the atmospheric air - 0.2 mg/m^3; the approximate permissible concentration (APC) in the soil - 0.6 mg/kg; the maximum permissible level (MPL) in cottonseed oil is "not allowed". It was found that the defoliant "NitroDEF" in terms of toxicity parameters belongs to the IV class of hazard (low-toxic compounds).

Keywords: pesticide, toxicity, medium lethal dose, irritant effect, hygiene standard, environment, regulations, safety.

Long-term fundamental and applied research contributed to the development of the synthesis of domestic environmentally friendly preparative forms of chemical plant protection products with the development of hygienic standards in environmental objects (water, soil, air) and food products and regulations for safe use.

Currently, the strategy for sustainable agricultural development includes the improvement of farming systems and provides for the optimal use of pesticides and mineral fertilizers. Without proper special measures, crop losses from a complex of pests, diseases and weeds can amount to significant damage. On the other hand, the country's agriculture is undergoing changes associated with the transition to resource-saving soil cultivation technologies, replacement of the vehicle fleet, replacement of plant protection products, etc. Of interest is the assessment of the changes taking

place in agriculture from a hygienic standpoint. The synthesis and testing of plant protection chemicals have taken on a huge scale. At the same time, the use of pesticides creates a potential danger to the health of the population, since many of them have a pronounced degree of harmful effect on the body, which is confirmed by numerous domestic and foreign publications [1]. According to previous studies, it is known that low-toxic pesticides, supplied in small quantities, but for a long time, can accumulate in objects of the environment and the body, adversely affecting them. Therefore, one of the most important hygienic problems is the prevention of the harmful effects of pesticides on the human body and the environment, and their regulation in environmental objects.

Purpose of the study: assessment of toxicity and development of hygienic standards and regulations for the safe use of the new defoliant "NitroDEF" when used in agriculture.

Materials and methods

Study of the new cotton defoliant "NitroDEF". Scientific research, on the toxic-logo-hygienic assessment, was carried out in accordance with the "Methodology for complex and accelerated rationing of pesticides in environmental objects" [2]. The degree of toxicity of the drug was determined according to the Sanitary Rules, Norms and Hygienic Standards of the Republic of Uzbekistan (SanPiN RUz) № 0321-15 [3].

Results and its discussion

Defoliant "NitroDEF". Physical state: solution, transparent, light yellow in color, with a slight aromatic odor. Ingredients: sodium chlorate, carbamides, monoethanolammonium nitrate, water. Specific gravity: 1.43 g/cm^3. Crystallization temperature: no more than 8°C. The drug is recommended for use in agriculture of the republic as a cotton defoliant.

The study of the acute toxicity of defoliant in order to establish the average lethal dose of the drug was carried out on 3 types of laboratory animals: white rats, mice, rabbits. The animals were injected intragastrically with the drug in doses of 1000.0 - 7000.0 mg/kg. At toxic doses, signs of intoxication were characterized by a sharp excitement of animals after administration of the drug, followed by depression, moisture in the coat, and minor convulsions. The clinic of intoxication in all animal species was the same. Statistical processing of the data obtained allowed us to establish the average lethal dose of the drug (LD_{50}): for white rats at the level of 4250.0 mg/kg, LD_{16} - 2375.0 mg/kg, LD_{84} - 6100.0 mg/kg; for white mice at the level of 4025.0 mg/kg, LD_{16} - 3275.0 mg/kg, LD_{84} - 4750.0 mg/kg; for rabbits at a level of 4700 mg/kg. Analysis of the data obtained allows us to conclude that the drug, according to the parameters of acute toxicity, belongs to substances of IV hazard class (low-hazard substance, Sanitary rules, norms and hygienic standards of the Republic of Uzbekistan № 0321-15).

The irritating effect of the drug on the skin was carried out on experimental animals - white rats. The drug was applied to the shaved areas of the skin in the abdominal region in its native form. After a 4-hour exposure, the preparation was washed off with running water and the experimental sites were monitored. After removing and washing off the preparation, slight edema and redness were observed on the test sites. The observed signs of irritation disappeared after 1 day from the beginning of the experiment, which suggests a weak local skin irritant effect.

The irritant effect of the drug on the mucous membranes of the eyes was studied on rabbits, in whose right eye 2 drops of the drug in a native form were introduced, the right eye served as a control. The introduction of the drug into the conjunctival sac of the eyes of animals led to anxiety in the animals, which tried to scratch the experimental eye with their paws. 1 hour after the introduction of the drug - there was a slight hyperemia, lacrimation. After 2 hours - narrowing of the palpebral fissure. By the end of the working day, the signs of irritation diminished and completely disappeared after 24 hours from the beginning of the experiment. Conclusion: the drug has a weak irritant effect on the mucous membranes of the eyes.

The study of the cumulative properties of the drug was carried out by the method of "subchronic toxicity" on white rats. The animals were divided into 2 groups, the weight of the animals was 150 - 180 grams, of both sexes. The first group received the drug at a dose of $^{1}/_{10}$ of the LD_{50}, the second group served as a control. Due to the absence of death of animals throughout the experiment, it was not possible to calculate the cumulation coefficient. However, according to the manifestation of some signs of intoxication and changes in the biochemical parameters of the blood of animals, it can be concluded that the drug has a weak functional cumulation.

Data on the toxicity of the drug for the intragastric route of administration are presented in table 1.

Table 1

Toxicity parameters of "NitroDEF" for warm-blooded animals with a single introduction into the stomach

№	Indicator	Value
1.	Medium lethal dose (LD_{50},): - white rats - white mice - rabbits	 4250.0 mg/kg 4025.0 mg/kg 4700.0 mg/kg
2.	Local skin irritant effect	slightly irritating
3.	Irritant effect on the mucous membranes of the eyes	slightly irritating
4.	Cumulative properties	poorly expressed of a functional nature

As a result of studying the chronic toxicity of the drug, the threshold and maximum inactive doses of the drug were set at 7.5 and 1.5 mg/kg. Based on the data obtained, the permissible daily dose for a person was calculated and scientifically substantiated - 1.8 mg/person/day.

Maximum permissible concentration (MPC) in water bodies. Most pesticides, getting into water bodies, can have an adverse effect on the organoleptic properties of water: change the smell, taste, color, color, transparency and thereby limit the sanitary conditions of water use by the population. The effect of the drug on organoleptic properties was studied. In the experiment, the concentration of defoliant in water was tested from 0.3 to 10.0 mg/l, with each of which 3 series of experiments were carried out. The results of the study showed that the drug gives the water a faint smell and taste. The threshold for the sensation of smell (intensity 1 point) was at 3.0 mg/l, and the practical threshold (2 points) was at the level of 7.0 mg/l. The taste threshold was 5.0 mg/l and the practical threshold was 10.0 mg/l. In view of fluctuations in threshold values due to the individual sensitivity of tasters (odorators), the results were processed by the statistical Student-Fischer method, taking into account the pop-up values, in order to find the lower confidence limit, the arithmetic mean value of the threshold concentration for taste and smell. In order to check the accuracy and correctness of the experiments, a graphical method for evaluating organoleptic data was used, which made it possible to establish that the intensity of the taste and smell of the drug increases in proportion to the logarithms of their concentrations, i.e. the data obtained correspond to the Weber-Fechner laws. When comparing the indicators of the intensity of the smell and taste of the drug in water (1 point) according to various research methods, it can be concluded that they are practically at the same level, which indicates the reliability of the studies (table 2).

Table 2

Influence of "NitroDEF" defoliant on organoleptic water properties according to various research methods

Organoleptic indicators and their intensity in points	**Method for analyzing the results obtained**		
	Concentration in mg/l		
	1	**2**	**3**
by smell			
sensation threshold	3.0	3.16	3.7
practical threshold	7.0	16.09	6.98
by taste			
sensation threshold	5.0	10.0	7.04
practical threshold	10.0	9.7	9.04

The drug at a threshold concentration in terms of its effect on odor did not change the color of water, transparency, and did not cause foaming. Based on the above, taking into account the data of the sanitary-toxicological experiment, the maximum permissible concentration (MPC) of the

drug in the water of reservoirs is recommended at the level of 3.0 mg/l, the limiting sign of harmfulness is organoleptic.

Maximum permissible concentration (MPC) in ambient and work area air. Based on generally accepted approaches to the hygienic regulation of harmful substances in the air, taking into account the toxicity parameters and physicochemical properties of the drug, the following are scientifically substantiated and recommended by calculation: maximum permissible concentration (MPC) in atmospheric air - 0.2 mg/m^3, maximum permissible concentration (MPC) in the air of the working area - 3.0 mg/m^3.

Approximate permissible concentration (APC) in soil and maximum permissible level (MPL) in plant products. Based on the methodology of complex regulation of pesticides in environmental objects and foodstuffs, the following are recommended: approximate permissible concentration (APC) of the drug in the soil at the level of 0.6 mg/kg; the maximum allowable level (MPL) in cottonseed oil is "not allowed".

When using defoliant "NitroDEF" in agriculture, it is necessary to be guided by the developed hygienic standards and regulations for the safe use of the drug (table 3).

Table 3

Hygienic standards and regulations for use defoliant "NitroDEF" in agriculture

№	Indicator	Value
1.	MPC in water of reservoirs, mg/l (limiting sign of harmfulness - organoleptic - smell)	3.0
2.	MPC in atmospheric air, mg/m^3	0.2
3.	MPC in the air of the working area, mg/m^3	3.0
4.	MPL in cottonseed oil, mg/kg	"not allowed"
5.	APC in soil, mg/kg	0.6
6.	Sanitary protection zone (SPZ), m	100
7.	Time to return to work, days	3

Conclusion

On the basis of the complex studies carried out, it was established that the NitroDEF defoliant belongs to the IV class in terms of toxicity; has a slightly irritating effect on the mucous membranes of the eyes and skin; cumulative properties are poorly expressed, of a functional nature. Recommended hygienic standards for the preparation: MPC in water of reservoirs - 3.0 mg/l, MPC in the air of the working area - 3.0 mg/m^3; MPC in atmospheric air - 0.2 mg/m^3; MPL in Cottonseed

Oil - Not Allowed; APC in soil - 0.6 mg/kg. Recommended regulations for safe use: sanitary protection zone (SPZ) - 100 meters, time to go to work - 3 days.

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