Phytotoxicity Increase of N-phosphonomethyl-glycine during the Ultrasonic Atomization with the Underdose of Organic Acids

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***Abstract* – In the article the results of laboratory tests on the combined application of nonselective system herbicide on the base of glyphosate, very-small dose of organic acids and ultrasonic atomization are presented. It lets minimize quantity of natural plants at lower concentration of herbicide in solution and accelerate the process of inhibition of drowth of plants.**

***Index Terms* – glyphosate, very-small dose, ultrasonic atomization**

I. INTRODUCTION

Maximum permissible doses of many herbicides in agricultural products are not defined, yet, but their danger does not give rise to doubts. The period of decomposition of glyphosate and decomposition products in soil depends on the climate and chemical composition of soil, in some case it can achieve three years. Residual quantity of glyphosate is found long after the treatment in strawberry, bilberry and raspberry, lettuce, carrot, barley aand fish. The consumption of polluted products, contact with polluted water and use of polluted water are the reasons of diseases and decrease of human immunity [1]. That is why reseaches on reduction of application rate of herbicides are actual.

II. PROBLEM STATEMENT

The aim of this paper is study of possible reduction of rate of N-phosphonomethyl-glycine (glyphosate) due to its use in the mixture with very-small doses of organic acids and its application by the method of ultrasonic atomization.

III. THEORY

There are some studies [2] on reduction of apllication rate of herbicide, e.g. due to their application together with the additives increasing their efficiency. Surface-active agents (adjuvants) are used as additives, which increase contact time of herbicide with the plant.

In 70s of past century In Biysk zone of Altay region the efficiency of herbicides was increased by its combined application with ammonium nitrate. Recommended norm of treatment of 1 hectare of grain against annual dicotyledonous weeds was 0.8...1.0 kg/hectare a.s. amine salt of 2,4-dichlorphenoxyacetic acid (2,4-D) (in fact 1.5…1.7 kg/hectare was applied). Such efficiency showed the application of 0.7 kg a.s. 2,4-D together with 1.5…2.0 kg of ammonium nitrate for 1 hectare of crops [3].

From last works it should be noted the application of urea with protectants and herbicides, e.g. [4], that allowed to reduce the norm of herbicide application in 30...50 %.

It is known the weed-killing composition on the base of glyphosate [5], where succinic acid and its derivatives in the amount of 0.1...30 % from herbicide are used as an additive. The composition increases efficiency and safety of herbicides. The disadvantage is high consumption and high cost of succinic acid at the traditional methods of herbicide application.

In this connection there is a need to find and study more effective methods of herbicides application, one of which is ultrasonic atomization of liquid media from vibrating surfaces (obtaining of aerosol).

IV. ULTRASONIC ATOMIZATION

Ultrasonic method of atomization of liquid ia used for conversion of liquid into aerosol. It occurs due to the increase of the surface energy of film of liquid, which is achieved by the imposition high-intensity mechanical vibrations on it. Aerosol is effective form of the application of medicines and disinfectants In this case maximum surface of interaction of sprayed particles and their equitability are provided. The method is widely used for disinfection and disinsection of accommodations, ambulance cars and equipment. Only in this case 100 % disinfection of difficult of access surfaces is provided.

The main advantages of ultrasonic atomization in comparison with all known methods (hydraulic, mechanical, pneumatic, etc.) are:

- low energy capacity;
- high productivity of the process;
- possibility to realize fine-dispersed dispersion;
- possibility to realize monodisperse dispersion;
- possibility to disperse high-viscous liquid without application of additional dispersant;

- presence of circulating currents in the drops of liquid accelarating the processes of heat exchange, mass transfer and others on the surface of the drop [6].

For the experiments the device of ultrasonic atomization of model UZR-0.15/44-OM was used, it had following performance features:

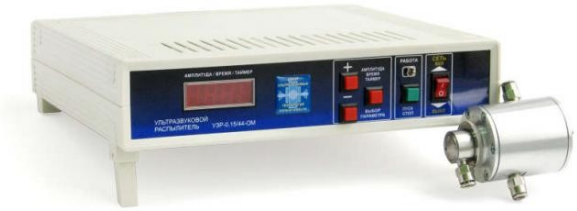

Fig. 1. The ultrasonic atomizer of model UZR-0.15/44-OM

Maximu viscosity of sprayed liquid, centipoise 20;
Mean size of sprayed particles, micromicron 40…50;
Productivity, ml/sec (water), no more than 2.

V. RESULTS OF THE EXPERIMENTS

In the experiment 3 specimen – wheat (*Triticum*), Phacelia (*Phacelia*) and runchweed (*Sinapis alba*) were used. We applied herbicide of entire action «Roundup» containing 360 g/l of glyphosate and 180 g/l of surface-active agent (TC - Producer – VR Moncanto Europe C.A., Belgium, producer – closed company firm «Avgust», Russia. It was produced in 2009.). The herbicide was used with the solution of organic acids, intermediates of Krebs cycle with the concentration of 10^{-11} M (very-small dose).

The spraying was made manually (garden sprayer) and by the ultrasonic atomizer UZR -0.15/44-OM till full watering of leaf area of plants in 14th day from planting. The size of drops was 50 micromicron. The consumption of the atomizer was 90 ml/min. Control plants were sprayed by water.

The solutions for atomizing were prepared by dilution of standard process solution of herbicide “Roundup” with water or water and the solution of very-small dose with concentration of 10^{-11} M. Mass concentration of process solution of glyphosate in the samples was 20, 80 and 100 %. The results of the experiments are presented in Tables 1, 2 and 3.

TABLE 1
PART OF SURVIVED PLANTS OF PHACELIA AFTER TREATMENT OF SOLUTIONS WITH DIFFERENT CONCENTRATION OF HERBICIDE

Variant	Part of survived plants, %			
	3 days	7 days	10 days	14 days
Control	100	100	100	100
Control + Ultrasound	100	100	100	100
Roundup 20%	100	100	47.9	20.5
Roundup 20% +Ultrasound	100	67.6	32.4	11.3
Roundup 20% + very-small dose	72.0	86.1	34.7	12.5
Roundup 20% + very-small dose + Ultrasound	76.0	60.5	19.7	6.6
Roundup 80% + very-small dose	61.3	32.0	2.7	0
Roundup 80% + very-small dose + Ultrasound	36.0	2.7	0	0
Roundup 100%	55.5	31.9	0	0
Roundup 100% Ultrasound	30.3	0	0	0

TABLE 2
PART OF SURVIVED PLANTS OF RUNCHWEED AFTER TREATMENT OF SOLUTIONS WITH DIFFERENT CONCENTRATION OF HERBICIDE

Variant	Part of survived plants, %			
	3 days	7 days	10 days	14 days
Control	100	100	100	100
Control + Ultrasound	100	100	100	100
Roundup 20%	100	100	91.1	91.1
Roundup 20% +Ultrasound	100	100	87.9	84.3
Roundup 20% + very-small dose	100	91.5	85.4	55.4
Roundup 20% + very-small dose + Ultrasound	100	87.6	82.0	35.0
Roundup 80% + very-small dose	100	17.7	5.1	0
Roundup 80% + very-small dose + Ultrasound	100	11.2	3.7	0
Roundup 100%	100	22.6	7.1	0
Roundup 100% Ultrasound	100	9.2	5.7	0

According to Tables 1 and 2 it can be concluded, that united application of very-small doses of organic acids with the ultrasonic treatment let minimize the number of alive plants at the low concentration of herbicide in the solution and at smaller period of influence. In two weeks all plants were killed at the mass concentration of 80 and 100 % of “Roundup” with ultrasonic and manual spraying.

a b

c

a– Control; b – Treatment with 100 % “Roundup”;
c – Ultrasonic treatment with 100 % “Roundup”
Fig. 2. Phacelia plants on the 3d day after treatment of 100% solution of “Roundup” manually and by ultrasonic atomization

Fig. 2 shows, that atomization with the help of ultrasonic device has better results on the third day after treatment at 100 % concentration of herbicide in the solution.

TABLE 3
PART OF SURVIVED PLANTS OF WHEAT AFTER TREATMENT OF SOLUTIONS WITH DIFFERENT CONCENTRATION OF HERBICIDE

Variant	Part of survived plants, %			
	3 days	7 days	10 days	14 days

Control	100	100	100	100
Control + Ultrasound	100	100	100	100
Roundup 20%	100	100	91.8	100
Roundup 20% +Ultrasound	100	100	88.9	100
Roundup 20% + very-small dose	100	100	90.7	87.3
Roundup 20% + very-small dose + Ultrasound	100	100	85.1	82.1
Roundup 80% + very-small dose	100	93.5	64.5	27.4
Roundup 80% + very-small dose + Ultrasound	100	86.1	58.4	24.6
Roundup 100%	100	83.3	31.7	11.6
Roundup 100% Ultrasound	100	78.3	25.0	0

From the data of Table 3 it is evident, that effect of the solutions with high concentration appeared only in two weeks after the treatment. At the end of the third week the amount of all plants at 100% concentration of “Roundup” solution together with ultrasonic treatment was minimized.

VI. DISCUSSION OF THE RESULTS

All plants of runchweed and phacelia were totally killed in two weeks at 80 and 100 % concentration of of “Roundup” in the solution together with ultrasonic and manual spraying, plants of wheat were killed in 3 weeks at 100 % concentration of “Roundup” in solution together with ultrasonic treatment.

The enhancement of influence of “Roundup” on the plants at the application of ultrasonic atomizer is observed at 100 % concentration of herbicide in the solution on the third day for phacelia and on the seventh day for runchweed. The influence of the preparatio on wheat was the least.

Thus, it can be concluded, that united application of the solution of N-phosphonomethyl-glycine, very-small doses of organic acids and ultrasonic atomization lets increase phytotoxicity of the herbicide in 20 %. The use of ultrasonic atomization accelerates the drop of alive plants in two times.

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