ORIGINAL ARTICLE

The efficiency of foliar treatments of grain crops and potatoes with humic preparation Rostock

I. V. Grekhova, A. V. Kurtova, O. V. Fedotova

Department of General Chemistry, Northern Trans-Ural State Agricultural University, Tyumen, 625003, Russia

Abstract

Aim: This article describes the results of four field experiments on the effect of foliar treatment with humic preparation Rostock in different phases of the development of spring wheat and oats, and potato varieties of different ripeness groups. Foliar treatment with humic preparation Rostock can be carried out on crops in all phases of development, but the effect in the flowering stage is weaker. **Materials and Methods**: Experiments on the effect of foliar treatments of humic preparation Rostock on spring wheat and oats were carried out on industrial crops of training experimental farm. **Results:** All the studied potato varieties have responded to foliar treatment with the Rostock in a tank mixture with an insecticide to increase yield and quality of tubers. **Conclusion:** Foliar treatment of crops with humic preparation Rostock can be carried out at all phases of development, but the effect at the flowering stage is weaker. All the studied potato varieties have effectively responded to foliar treatment with the Rostock in a tank mix with insecticide.

Key words: Foliar treatment, humic preparation Rostock, oats, potatoes, spring wheat

INTRODUCTION

Humic preparations are natural regulators of growth and development of plants. They change the course of all physiological and biochemical processes of plants (photosynthesis, respiration, carbohydrate and protein metabolism, transpiration, and intensity of mineral nutrition), the morphogenesis, and the rate of passage of phenological phases, which increases crop yields and improves product quality. In addition, humic preparations have antistress and antimutagenic properties.[1] The greatest effect of the preparations is observed when the deviation from the optimal is at least one of the factors in the growth and development of plants.[2]

Production of humic preparations is based on properties of humic acids of caustobioliths, to form a soluble salt with alkaline metals or ammonium. The composition of humic substances depends on the source of raw peat, plants of peat-forming plants, reagents, and conditions of extraction of humic acids.[3] At present, humic preparations are manufactured by many enterprises from various natural raw materials. We believe that the most environmentally friendly raw material is raised bog and fen peat. It is important to select the optimal mode that preserves their natural biological properties when extracting humic acids. At high temperature and concentration of the reagent, the yield of humic acids can be increased, but there is a risk of reducing the efficacy of plants.

The method of obtaining humic preparation from fen peat was patented at SAU Northern Trans-Ural.[4] OOO "SPC "Eureka" produces humic preparation Rostock on the basis of the technology. Humic acids precipitate, the supernatant solution containing aggressive fracture of fulvic acids and impurities remove in the manufacture of the Rostock from the hydrolysate. This is, first, allows obtaining the preparation with a stable composition. The content of humic acid is monitored in each batch of the preparation by optical density. Consistency of composition guarantees application of the recommended dose (0.001% working solution) and

Address for correspondence:
I. V. Grekhova, Department of General Chemistry, Northern Trans-Ural State Agricultural University, Respubliki Str. 7, Tyumen, 625003, Russia.
E-mail: grehova-rostok@mail.ru

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the stability of effect of the preparation on different cultures. Second, nozzles of sprayers do not become clogged while using the Rostock.

The technology allows you to get ballast less humic preparation with a high content of paramagnetic centers, which increases the efficiency. Paramagnetic activity is a fundamental property of humic acids.[5]

A small concentration of the working solution of the Rostock contributes to the unwinding of the packing of polymer chains and changes the configuration of the molecules of humic acids that accelerate the penetration of the drug through the cell membranes.

Extra macro- and micro-nutrients are deliberately not added in the Rostock. The plants get a small amount of macronutrients when using concentration of the working solution of the regulator. Moreover, it is necessary to know the content of micronutrients in the soil when adding them. It is better to just add a pure regulator to a tank mixture of pesticides and fertilizers. In the first case, the Rostock reduces chemical stress, and in the second case, it increases the utilization of nutrients from the fertilizer by 2 times.

A positive effect of presowing treatment of seeds and foliar treatment, including grain crops in the tillering stage, with the Rostock on the growth and development of plants was proved through numerous laboratory, field, and industrial experiments.[6-8] It is necessary to determine the effect of increasing the ratio of foliar treatments on productivity of grain crops. Different reactions of varieties of potato to the method of application of the regulator have been revealed in the Northern forest-steppe of the Tyumen region that has pushed to the testing of the Rostock on other varieties.[9,10]

RESEARCH METHOD

Experiments on the effect of foliar treatments of humic preparation Rostock on spring wheat and oats were carried out on industrial crops of training experimental farm. The effect of double and 3 times treatment with Rostock was studied during the first experiment (2008–2010) on spring wheat variety Novosibirskaya-15. The first treatment was carried out at the tillering stage, second - at the earing phase, and the third - at flowering stage. The Rostock at the flowering and milky stage of spring wheat Novosibirskaya-31 when foliar treatment with tank mixture of herbicide Puma Plus Rostock was tested at the phase of tillering in the second experiment (2012–2013, 2015). The first foliar treatment of plants was carried out at the tillering stage in the third experiment (2008–2010) on the oat cultivar Talisman, the second treatment - at the phase of blossom's ear formation. Plants of spring wheat and oats were sprayed in the experiments with a solution of the preparation of 0.001% concentration at the consumption of the working solution of 200 l/ha.

The influence of the Rostock on potatoes with different ripeness was studied during the fourth experiment (2014–2016): Early ripening variety - Kamensky; middle early varieties - Irbitsky, Lina, Sapho, and Tuleevsky; and midseason varieties - Nakra and Chudesnik. Potato tubers were soaked in water (control) and 0.002% solution of the Rostock within 30 min. The Rostock (20 ml/10 l of 0.002% solution) was added in a solution of insecticide Prestige Chameleon (1 ml/10 L) when foliar treatment at the phase of bud formation. Solution consumption was 300 l/ha. The crop structure was determined by the method of state trials (1983). Fibrin content in a grain was determined according to the GOST 13586.1-68, dry matter content in the potato tubers was determined according to the GOST P52838-2007, starch - according to the GOST 7194-81.

RESULTS

The Influence of the Rostock on Cereals

The application of humic preparation Rostock in the first experiment had a positive impact on the number of productive stems of spring wheat: Double treatments exceeded the damp and dry control by 21 and 16%, 3 times - by 22 and 17%, respectively. The ear grain content and grain weight per spike are above the controls, but the difference between the variants is insignificant [Table 1]. On average, the yield of spring wheat variety has significantly increased over the 3 years of foliar treatment with humic preparation Rostock: Novosibirskaya-15 by 7 (24%) and 6 kg/ha (20%) compared with dry and damp control, respectively. The third treatment did not affect the yield; increase was the same as with the double treatment.

In the second experiment, foliar treatment at all phases of the development of spring wheat variety Novosibirskaya-31 had a positive impact on indicators of crop structure. On average over 3 years of research yield of spring wheat from the effect of foliar treatment of humic preparation Rostock at the tillering stage and twice in the phase of tillering and milk stage, compared with damp and dry controls increased by 0.7 t/ha [Table 1]. While treating with the Rostock at the flowering stage, the yield increases are by 0.4 t/ha lower than at the phase of tillering and milky stage. The fibrin content in the grain of spring wheat exceeded the damp control: Single treatment at the tillering stage by 3.0%, double treatment at phases of tillering and flowering - 3.9%, and double treatment at phases of tillering and milky stage - by 5.4%. Foliar treatment with humic preparation Rostock provided not only yield increase but also the increase in the content of fibrin in a grain.

The application of humic preparation Rostock had a positive impact on the development of plants of oats. The number of productive stems of plants with single and double treatment

Table 1: Effect of foliar treatment with humic preparation Rostock on spring wheat

Options (phase of application)	The ear grain content, pcs	Weight of grains per spike, g	Yield, t/ga
Novosibirskaya-15 (2008–2010)			
Dry control	26	0.9	2.9
Damp control	28	0.9	3.0
Rostock (tillering and heading)	28	1.0	3.6
Rostock (tillering, heading, and flowering)	29	1.0	3.6
HCP05	3.9	0.2	0.2
Novosibirskaya-31 (2012–2013, 2015)			
Dry control	29	1.1	3.7
Damp control	29	1.1	3.7
Rostock (tillering)	32	1.2	4.4
Rostock (tillering and heading)	31	1.2	4.0
Rostock (tillering and milk ripeness)	31	1.3	4.4
HCP05	2.5	0.1	0.2

with preparation Rostock is by 17 and 31% more compared to the damp control [Table 2].

Single and double treatment with water had no impact on yield of the oats. A single foliar treatment with humic preparation in comparison with dry and damp control has significantly increased the yield of the oats by 26 and 28%, double - by 19 and 21%, respectively.

Influence of Humic Preparation Rostock on Potato

The productivity of potato is formed from the number of tubers in the seedbed and the mass of one tuber. The demonstration of these structural elements of yield depends on variety and growing conditions. Foliar treatment with the Rostock in tank mixture with insecticide increased the number of marketable tubers of the medium-early varieties: Lina - 10%, Sapho - 7%, Irbitsky - 45%, Tuleevsky - 32% and midseason varieties: Nakra - 7% and Chudesnik - 46% [Table 3].

Difference in the number of marketable tubers of early ripening varieties Kamensky between control and treatment of plants with the Rostock is insignificant. Weight of marketable tubers increased at early ripening varieties Kamensky by 22%; middle early varieties: Lina - by 10%, Sapho - by 36%, Irbitsky - by 24%, and Tuleevsky - by 22%; and midseason varieties: Nakra - by 32% and Chudesnik - by 4%. The Rostock has equally influenced the number and weight of marketable tubers of Lina varieties. The greater the increase in the number of marketable tubers, the less weight increase of marketable tubers at the rest of the varieties.

The average 3-year yields increased at the early ripening varieties Kamensky by 16%; medium-early varieties: Lina - by 22%, Sapho - by 46%, Irbitsky - by 80%, and Tuleevsky - by 63%; and midseason varieties: Nakra - by 43% and Chudesnik - by 57%.

Foliar spraying of potato plants with the Rostock in a tank mix with insecticide increased the contents of dry matter and starch in potato tubers in average for 3 years at early ripening varieties Kamensky by 11.4 and 4.5% (61 and 41 frac. %); middle early varieties: Lina - by 4.2 and 3.0% (20 and 20 frac.%), Sapho - by 4.9 and 4.3% (24 and 30 frac. %), Irbitsky - by 3.7 and 0.8% (16 and 4 frac. %), and Tuleevsky - by 3.5 and 6.3% (16 and 40 frac.%); and midseason varieties: Nakra – by 3.6 and 2.3% (14 and15 frac. %) and Chudesnik – by 2.7 and 3.6% (13 and 23 frac. %), respectively.

DISCUSSION

When applying humic preparation Rostock the grain yield of spring wheat varieties Novosibirsk-15, Novosibirsk-31, oat variety Taezhnik compared to control increased by 0.6–0.7, 0.3–0.7 and 0.8–1.1 t/ha, respectively, gluten content increased by 3–5% in the grain of spring wheat at variety Novosibirskaya-31. The third foliar treatment in the phase of milky ripeness of spring wheat did not provide any significant effect on yield, but the gluten content in grains exceeded all the options.

Foliar treatment of seven potato varieties of different ripeness groups in a tank mix with the insecticide with the Rostock provided an increase in the number of marketable tubers by 7–46%, weight of marketable tuber - by 19–36%, the yield - by 22–80%, and increase of the dry substance and starch in potato tubers – by 4–61%.

Table 2: Effect of foliar treatments with humic preparation Rostock on oats Talisman (2008–2010)

Options	Frequency of treatment	The number of productive stems, pieces/м2	Yield, t/ga
Dry control		440	3.96
Damp control	Once	449	3.92
	Twice	445	3.90
Rostock	Once	525	5.01
	Twice	584	4.70
HCP05		24.5	0.102

Table 3: Influence of foliar treatment on yield and quality of potato tubers (2014–2016)

Options	Yield, t/ga	Content, %	
		Dry matter	Starch
Kamensky			
Insecticide	38.2	18.6	10.9
Insecticide+Rostock	44.3	30.0	15.4
Lina			
Insecticide	43.0	21.0	15.2
Insecticide+Rostock	52.4	25.2	18.2
Sapho			
Insecticide	46.0	20.2	14.3
Insecticide+Rostock	67.0	25.1	18.6
Irbitsky			
Insecticide	33.8	22.8	19.4
Insecticide+Rostock	61.0	26.5	20.2
Tuleevsky			
Insecticide	42.0	22.4	15.9
Insecticide+Rostock	68.6	25.9	22.2
Nakra			
Insecticide	33.8	26.0	15.7
Insecticide+Rostock	48.3	29.6	18.0
Chudesnik			
Insecticide	18.3	20.5	16.0
Insecticide+Rostock	28.7	23.2	19.6
HCP05	5.19	-	-

CONCLUSION

Foliar treatment of crops with humic preparation Rostock can be carried out at all phases of development, but the effect at the flowering stage is weaker. All the studied potato varieties have effectively responded to foliar treatment with the Rostock in a tank mix with insecticide.

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