Effect of different zinc concentrations on the growth functions of spring wheat seedlings

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Abstract. In laboratory experiments, the effect of different concentrations of zinc on the growth processes of seedlings of spring wheat cv. Ester was studied. The optimal concentration of zinc for seed treatment before sowing was revealed. The optimal concentration of zinc has a positive effect on the length of sprouts and roots, as well as the photosynthesis of seedlings of spring wheat in the early stages of development.

1 Introduction

In laboratory experiments, the effect of different concentrations of zinc on the growth processes of seedlings of spring wheat cv. Ester was studied. The optimal concentration of zinc for seed treatment before sowing was revealed. The optimal concentration of zinc has a positive effect on the length of sprouts and roots, as well as the photosynthesis of seedlings of spring wheat in the early stages of development.

Spring wheat is the main grain food crop. The sown areas of grain crops in the country have increased in recent years and most of them are areas occupied by wheat [1]. The productivity of spring wheat depends largely on the conditions of mineral nutrition, which are associated with the formation of a different number of spike-bearing tillering shoots. Obtaining high stable crop yields in the Nonchernozem zone is limited mainly by providing plants with nitrogen [2].

With a lack of nitrogen in plant nutrition, inhibition of growth processes is observed. The intensification of growing technology should include the use of high doses of mineral fertilizers, especially nitrogen fertilizers, with the obligatory observance of measures that ensure the preservation of the environment [3]. The stability and magnitude of yields depends on agricultural practices, as well as on unregulated meteorological environmental factors. The temperature and amount of precipitation during the growing season have a significant impact on the yield and quality of the products obtained [4, 5]. Recently, the aridity of the climate has been increasing in the whole world [6]. The nonchernozem zone is characterized by unstable moisture. In different years, both insufficient and excessive moisture conditions are observed. These unfavorable conditions most often occur during the critical period of growth and development of spring wheat plants - the laying of reproductive organs (stage VI of organogenesis). This is the reason for the decrease in the number of grains in the ears and the formation of empty ears. This contributes to a sharp decrease in the yield of agricultural plants [7-10].

When water metabolism is disturbed, a change occurs in the balance of stomatal and mesophilic resistance. With an increase in air temperature, the concentration of abscisic acid increases and stomata close. At the same time, the absorption of carbon dioxide decreases, photosynthetic processes are suppressed. This leads to inhibition of carbohydrate synthesis processes. [11].

Under conditions of abiotic stresses, it becomes necessary to use microelements that increase the resistance of agricultural plants. Numerous studies have shown that zinc contributes to the activation of the adaptive potential of plants. Zinc stimulates various vital processes, which leads to an increase in plant productivity under stressful conditions [12-14]. Adaptation of plant organisms is due to a change in the intensity and direction of metabolic processes. One of the criteria for plant sensitivity to stress conditions is linear growth and the activity of photosynthetic processes [13, 14].

Thus, the search for methods to prevent the negative consequences of adverse moisture conditions and ensure high stable yields, which is an important and urgent problem. The aim of our work was to study the possibilities of reducing the adverse effect of insufficient soil moisture by regulating the nutrition of plants with zinc.

2 Research methods

To solve the questions raised, a laboratory experiment was carried out with seedlings of spring wheat of the Ester variety. Wheat plants were grown in containers with a capacity of 1 kg of soil. Soddy-podzolic medium loamy soil was used for research. The duration of the experiment was 21 days. In studies, the effect of different concentrations of zinc on seed germination (%), sprout length (cm) and root length (cm), as well as the intensity of seedling photosynthesis (mg CO2/h) was determined. In studies for seed treatment before sowing, solutions of various concentrations of zinc sulfate were used at the rate of 0.15,30,60,90,120 g per 1 seed center.

3 Research results

It is known that the use of seed treatment with zinc salts before sowing is one of the most effective ways to increase crop yields. Recommendations have been developed for the use of zinc in seed treatment before sowing wheat seeds. However, the doses of zinc in individual recommendations sometimes differ significantly. In this regard, in our studies, we studied the effect of various doses of zinc on the growth processes of seedlings of spring wheat cv. Ester. As a result of the research, it was found that zinc has a positive effect on the nature of the growth of spring wheat from the first stages of development (Figure 1). Seed treatment before sowing in small doses of zinc (15–30 g/centner of seeds) had an insignificant effect on seed germination. An increase in zinc concentration to 60–120 g/centre of seeds caused some increase in germination, but the fluctuations did not exceed 3–5%. (Figure 1).

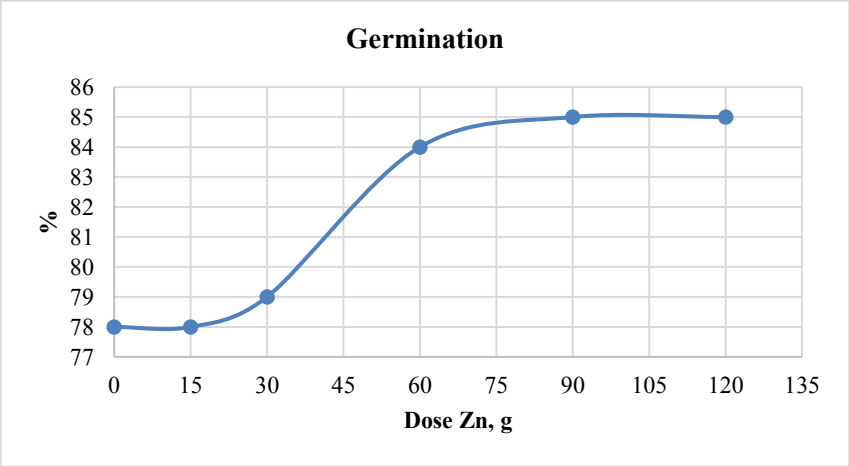

Fig. 1. Effect of different Zn concentrations on the germination of spring wheat seeds.

Figure 2 shows that the treatment of seeds with zinc before sowing led to an increase in the intensity of growth processes during the juvenile period. The high intensity of growth of the assimilation surface, especially the roots during this period, is of great importance for the use of moisture and serves as the basis for a better experience of subsequent moisture deficiency. The highest length of sprouts and roots was noted at a concentration of 30 g/cwt of seeds, an increase in concentration to 60-120 g/cwt of seeds led to a sharp decrease in these indicators, and this is especially evident in Figure 2. The intensity of photosynthesis also increased when seeds were treated with zinc before sowing and the concentration was increased to 30 g/centner of seeds, however, a subsequent increase in the dose of zinc had no effect on this process (Figure 3).

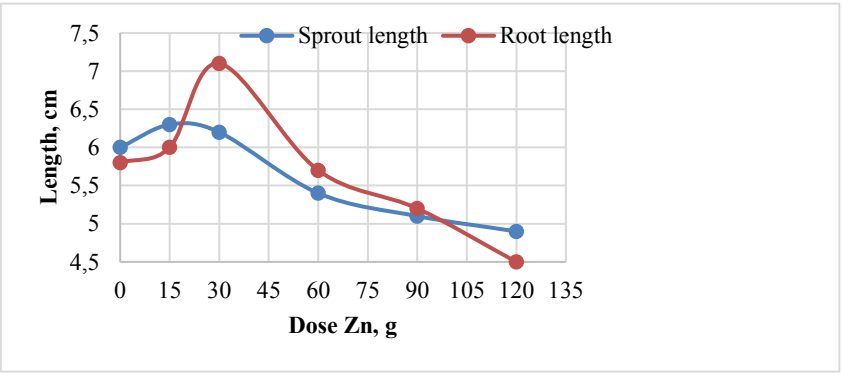

Fig. 2. Influence of the different Zn concentrations on the spring wheat growth indicators.

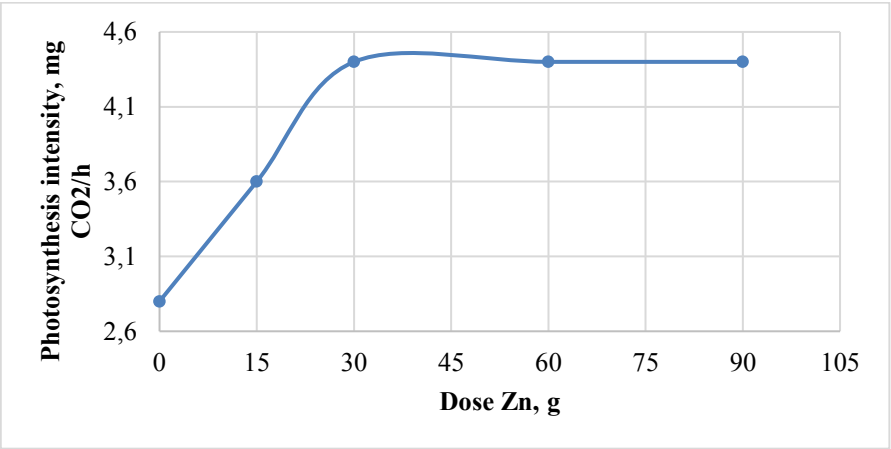

Fig. 3. Photosynthesis intensity in depending on zinc concentration.

Thus, based on the conducted studies, it can be concluded that it is expedient to use zinc for pre-sowing treatment of spring wheat seeds at a dose of 30 g / centner of seeds, which is consistent with individual recommendations.

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