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Research Article

Effects of Plant Growth Regulator on Growth Traits in Wheat Seedlings under Different Salt Concentrations

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Abstract: To reduce the damage caused by salt stress on wheat, we studied the effects of plant growth regulator on growth traits in wheat seedlings under different salt concentrations by setting different salt concentrations. The results showed that the plant growth regulator had effects on leaf length, plant height, aboveground fresh weight, underground fresh weight and root-shoot ratio under 0.1, 0.2, 0.3 and 0.4%, respectively salt concentration, but the effects to improve growth traits of 0.2% salt concentration were most obvious. So studying effects of plant growth regulator on growth traits in wheat seedlings under different salt concentrations has a theoretical and practical significance in salt tolerance and wheat cultivation in saline alkali soil.

Keywords: Growth traits, plant growth regulator, salt concentration, wheat

INTRODUCTION

As a big problem of agriculture, the proportion of saline-alkali land is large for total area of the cultivated land in our country. With some improper factors, arable land area decreases sharply (Lin *et al*., 2014). So the comprehensive development and utilization of saline-alkali land, biological treatment and studying on salt tolerance of wheat are very necessary. Studying changes of wheat physiological and biochemical indicators with salt stress can reveal wheat salt tolerance mechanism, rich physiological content of salt tolerance and provide a theoretical basis for the species selection and wheat cultivation in saline alkali soil. With salt stress, growth rate will lower, leaf will damage and root-shoot ratio will increase (Hong *et al*., 2014). The mechanism includes osmotic stress and ion toxicity. And wheat is necessary for our life. So the need for wheat is very large, but the saline-alkali land can cause wheat yield reduction and have a certain effect on long lines, plant height, aboveground fresh weight, underground fresh weight and root-shoot ratio, causing physiological and biochemical disorder (Zhuangwang, 2002).

Based on above problems, plant growth regulator has been widely studied and applied as an effective measure to regulate crops growth. It is the products of organic synthesis, micro analysis, plant physiology and biochemistry, as well as the modern agriculture forestry horticulture, etc. with comprehensive development. And saline-alkali land becomes an important issue, such as the disorder of physiology and biochemistry under salt stress, the destruction on biological membranes structure and function to limit crop yield increasing. At present, there are many ways to solve such problems, such as irrigation, fertilization and others. But these measures have many drawbacks. The demand for water is great and the cost of irrigation facilities for using water resources is high, moreover the effects are not obvious. Large amount of fertilization will cause secondary pollution of land, even to form irreparable situation with the land being not cultivated. Recently, plant growth regulator is widely used for regulating crop growth. There are many reports about plant growth regulator for wheat. The results of some scholars (Dangxiao *et al*., 2002) indicate that dressing and spraying with plant growth regulator have a certain effect. Other scholars (Yulei *et al*., 2001) study the effect of plant growth regulator on wheat yield. Although the studies about plant growth regulator on wheat growth and development are many, but the effects of plant growth regulator on wheat with salt stress is little. This study mainly study the effects of plant growth regulator on leaf length, plant height, aboveground fresh weight, underground fresh weight and root-shoot ratio under 0.1, 0.2, 0.3 and 0.4% salt concentration. That is to provide a theoretical basis for the plant growth regulator to slow down the impact of saline-alkali land on crops.

MATERIALS AND METHODS

Experiment materials: The experiment selects Jimai22 as wheat material, plant growth regulator is

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Table 1: Experimental treatments (unit: g/667m^2)

Treatment	CK	T1	T2	T3	T4
Plant growth regulator	12	12	12	12	12
Nacl (%)	0	0.1	0.2	0.3	0.4

Chek. Indole B. Brassicas. Its total effective component content is 0.136%. Besides the content of gibberellic acid is 0.135%, of indole acetic acid is 0.00052% and of brassinolide is 0.00031%

Experiment design: The experiment consists of five treatments, as is shown in Table 1. They are the control (CK), treatment 1 (T1), treatment 2 (T2), treatment 3 (T3) and treated 4 (T4) respectively. Each treatment sets 3 repeats. Basin length, width and height are 20, 13.5 and 7 cm. Wheat seedlings are placed in artificial climate chamber with same management. Pour 100ml water every day to grow up to three leaves. After pour 50 mL 0, 0.1, 0.2 and 0.4% salt water, respectively. At the same time, spray same amount of plant growth regulator on three-leaf stage and spray once every seven days. Take the sample at four-leaf stage and then take once with 3 strains of wheat every seven days to measure leaf length, plant height, aboveground and underground fresh weight and root-shoot ratio.

RESULTS

Effects of plant growth regulator on leaf length in wheat under different salt concentrations: In Fig. 1, the overall trend of leaf length gradually increases, but there are some differences among different salt concentrations treatments at different times. In 21 days after four-leaf stage, leaf length is T2> T3> T1> CK> T4. Leaf length of CK, T1, T2, T3 and T4 increase 11.8, 15.2, 16.3, 18.7 and 16.3%, respectively from 0 to 7 days after four-leaf stage, namely T3> T2> T1> CK> T4. From 0 to 21 days after four-leaf stage, the increasing extent of CK, T1, T2, T3 and T4 are 46, 44.3, 56.3, 53 and 42.9%, respectively, namely T2> T3> CK> T3> T4.

Effects of plant growth regulator on plant height in wheat under different salt concentrations: We can make it out from Fig. 2 that plant height of treatments is rising gradually. But there are some differences among different treatments in different periods. Plant height is T2>T3> T4>T1>CK during 21 days after four-leaf stage. From 0 to 14 days four-leaf stage, plant height of CK, T1, T2, T3 and T4 increase by 15.1%, 21.6, 26.3, 21.6 and 19.9%, respectively, namely T2> T1> T4> T3> CK. The change extent of CK, T1, T2, T3 and T4 are 17, 24.2, 33.9, 24.2 and 23.4%, namely T2> T1> T4> T3> CK. Plant height of T2 rises by 5.56cm. The change extent is the largest and most obvious.

Effects of plant growth regulator on aboveground and underground fresh weight in wheat under different salt concentrations: From Fig. 3 and 4 that general trend of aboveground and underground fresh

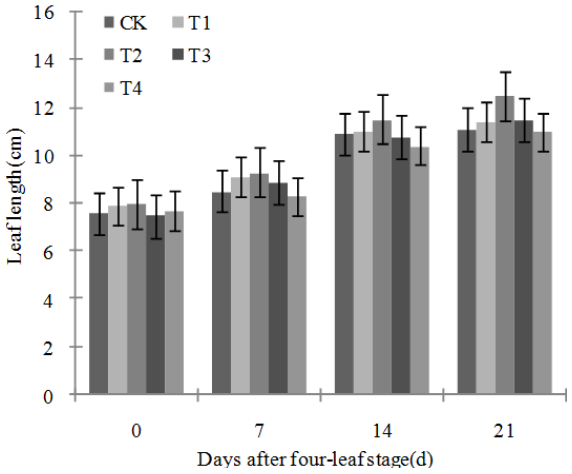

Fig. 1: Effects of plant growth regulator on leaf length in wheat

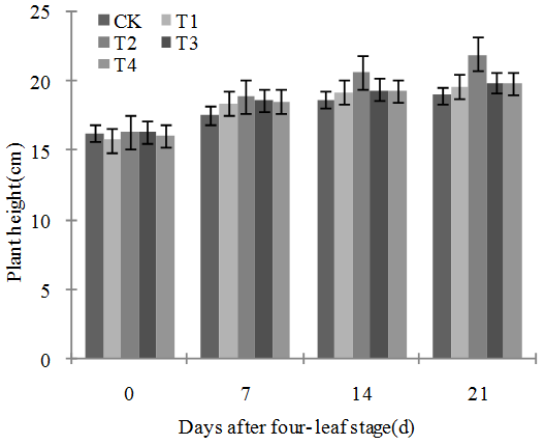

Fig. 2: Effects of plant growth regulator on height in wheat

weight is from low to high. And the most significant is T2. During 0 day, 7 days, 14 days and 21 days after four-leaf stage, aboveground and underground fresh weight of T2 are significantly higher than of other treatments. From 0 to 7 days after four-leaf stage, aboveground fresh weight of CK, T1, T2, T3 and T4 increase by 60.5, 69.5, 70.7, 39.6 and 70.7%, respectively, namely T2> T1> T4> CK> T3; of CK, T1, T2, T3 and T4 increase by 23.9, 14.5, 17.9, 29.4 and 17.9%, respectively from7 to 14 days after four-leaf stage, namely T3> CK> T2> T4> T1. For underground fresh weight, CK, T1, T2, T3 and T4 increase by 19.4, 66.9, 31.4, 31.3 and 44.4%, respectively during 0 and 7 days after four-leaf stage, namely T1> T4> T2> T3> CK. From 7 to 14 days after four-leaf stage, CK, T1, T2, T3 and T4 increase by 58.1, 13.2, 18.7, 10.5 and 18.7%, namely CK> T2> T1> T3> T4.

Effects of plant growth regulator on root-shoot ratio in wheat under different salt concentrations: We can find out from Table 2 that root-shoot ratio of treatments

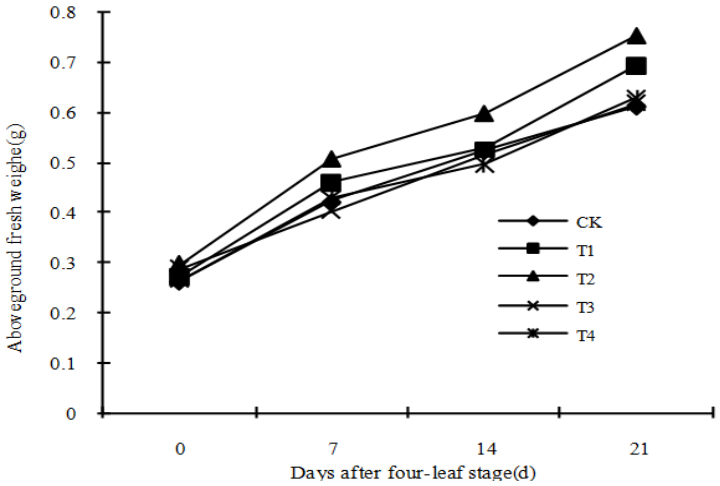

Fig. 3: Effects of plant growth regulator on aboveground fresh weight in wheat

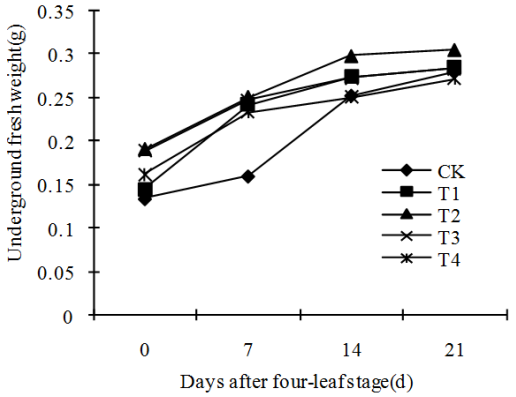

Fig. 4: Effects of plant growth regulator on underground fresh weight in wheat

Table 2: Root-shoot ratio of treatments during days after four-leaf stage

Treatment	0	7	14	21
CK	0.510	0.379	0.484	0.457
T1	0.533	0.525	0.519	0.409
T2	0.643	0.495	0.498	0.405
T3	0.653	0.614	0.525	0.458
T4	0.611	0.544	0.505	0.431

is broadly in line with a similar trend which reduces gradually. But there exist differences in the change extent among treatments at the same time. From 0 to 21 days after four-leaf stage, CK, T1, T2, T3 and T4 decrease by 10, 23.3, 37, 30 and 29.5%, namely T2> T3> T4> T1> CK. During 0 day after four-leaf stage, root-shoot ratio is T3> T2> T4> T1> CK. And it is T3> CK> T4> T1> T2 during 21 days after four-leaf stage.

DISCUSSION AND CONCLUSION

Effects on leaf length in wheat: Leaf length mainly reflects the state of wheat growth. In this experiment, CK, T1, T2, T3 and T4 increase by 11.8, 15.2, 16.3, 18.7 and 7.8%, respectively from 0 to 7 days after four-leaf stage. The reason may be because the wheat has salt tolerance by itself (Caifeng *et al*., 2012). With their own resistance of salt, the damage can be reduced. So the effects on normal development of wheat are smaller. The change extent of CK, T1, T2, T3 and T4 are T2> T3> CK> T1> T4. The result explains that the regulation of plant growth regulator is different (Jinmin *et al*., 2013). To some extent, effects of plant growth regulator on wheat under 0.2% concentration are the most obvious. The reason may be because the degree of damage and regulation are roughly equal under his concentration. Therefore, leaf length of T2 is best.

Effects on plant height in wheat: Plant height represents the growth rate and potential of wheat. Generally plant height is high and the growth potential is great. In this test, plant height is T2> T3> T4> T1> CK during 21days after four-leaf stage. From 0 to 21days after four-leaf stage, change extent is T2> T1> T4> T3> CK. T2 is the largest and most obvious. This may be due to salt stress has an effect on permeable membrane (Desai *et al*., 2011) and that will directly affect cell membrane to influence normal development (Jianwei and Hong, 2014). And 0.2% concentration is more conducive to the balance of internal and external environment of wheat. 0.1, 0.3 and 0.4% concentration break the balance with light or heavy (Jianwei and Hong, 2014; Hongbo *et al*., 2012).

Effects on aboveground and underground fresh weight in wheat: Aboveground fresh weight represents the accumulation of organic matter and water content. Underground fresh weight reflects root absorption and moisture (Yang *et al*., 2009). In this test, aboveground and underground fresh weight of T2 is higher than other treatments during 0 day, 7 days, 14 days and 21 days after four-leaf stage. The increase extent is T2> T1> T4> CK> T3 from 0 to 7 days after four-leaf stage. Because the suppression of 0.3 and 0.4% concentration

are bigger than of 0.1% and 0.2% concentration. So plant growth regulator can slow down the suppression of T2 and T1.In addition, the change extent of underground fresh weight are CK> T2> T1> T3> T4 during 7 and 14 days four-leaf stage. Probably because the damage with 0.2% concentration is lower than other concentrations under applying plant growth regulator.

Effects on root-shoot ratio in wheat: Root-shoot ratio mainly reflects the coordination between underground and above-ground. It is an important factor of influence wheat yield (Shujie *et al*., 2003). During 0 day after four-leaf stage, shoot ratio showed is T3> T2> T4> T1> CK and is T3> CK> T4> T1> T2 during 21 days after four-leaf stage. The result explains that the effects of plant growth regulator on root-shoot ratio are different (Ling *et al*., 2009) and the effect is more significant for T2.From 0 day to 21 days after four-leaf stage, decrease extent are T2> T3> T4> T1> CK. The reason is that salt has a direct impact on underground, so the growth of underground is limited (Zening *et al*., 2014). Meanwhile, plant growth regulator promotes the growth of aboveground. Therefore when the salt concentration is 0.2%, the plant growth regulator can coordinate root-shoot ratio best.

Above all, plant growth regulator has a certain coordination role on root-shoot ratio in wheat under salt stress. To some extent, it can promote leaf length, plant height, aboveground and underground. But the effects are different among them. The results indicate that plant growth regulator influence on CK, T1, T2, T3 and T4 differently. However the regulation on T2 with 0.2% salt concentration is most significant. Therefore studying effects of plant growth regulator on growth traits in wheat seedlings under different salt concentrations has a theoretical and practical significance in salt tolerance and wheat cultivation in saline alkali soil.

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