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Research Article

Effects of Magnetized Saline on Growth and Development of Winter Wheat Seedlings

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Abstract: In order to explore the effects of magnetized saline solution treatment on crop growth and development, with Jimai 22 as experimental material, this experiment studied the effects of magnetized water solution of 0.3% NaCl and 0.5% NaCl, groundwater solution of 0.3% NaCl and 0.5% NaCl on SPAD value, soluble protein content and activities of Superoxide Dismutase (SOD) and Catalase (CAT) of winter wheat. The results showed that, under the conditions of this experiment, the wheat of the magnetized saline solution treatment had lower SPAD value, higher soluble protein content and higher activities of superoxide dismutase and catalase with the seedlings growing better than the wheat of the saline solution treatment. Magnetized saline solution increased the salt resistance of wheat and promoted the growth and development of wheat.

Keywords: Catalase, chlorophyll, soluble protein, superoxide dismutase, winter wheat

INTRODUCTION

The magnetized water is water which is magnetized. It is made by ordinary water which is allowed to get through the magnetic field of certain intensity with a certain flow rate, along with a direction perpendicular to the magnetic field lines. The physical and chemical properties of magnetized water have a series of changes which lead to special functions.

Recently, there has been a widespread concern about magnetic which is widely used at home and abroad in metallurgy, chemical industry, medicine, agriculture and other fields. China has gradually concerned about the study on magnetic treatment to crop drought resistance and hardiness. Salinization of soil is a key factor restricting the yield of crops, which has become a global threat to agricultural development. There has been some researches of salt stress on crop growth and development (Guo *et al*., 2007; Yang *et al*., 2007) and a considerable amount of researches on effects of magnetized water on crops physiological and biochemical (Zhou *et al*., 2008; Qiu *et al*., 2011; Zhou *et al*., 2012; Liu *et al*., 2002; Yang, 2003; Lu and Huang, 2005) and few researches on magnetized saline solution treatment on crop growth and development (Shimin and Guocheng, 2000; Xie, 2010).

This experiment studied the effects of saline and magnetized saline on SPAD value, soluble protein content and activities of superoxide dismutase (SOD) and catalase (CAT) of winter wheat with Jimai 22 as experimental material. Studying the physiological changes and the effects of magnetized saline on wheat growth and development under salt stress, provides a theoretical basis for the breeding of salt tolerance varieties and the development and utilization of soil salinization.

MATERIALS AND METHODS

Materials and design of experiment: The experiment was carried out in Artificial Climate Incubator of Qingdao Agricultural University (36.30°N, 120.36°E) laboratory from January 10th to January 30th, 2013, with Jimai 22 as experimental materials. Filled 10 boxes which size were of 260×190×70 with air-dried soil, respectively. Each box was planted six wheat seedlings which would be placed in incubator of 26°C.

To set up five different treatments with each treatment two repeats, which were groundwater solution (CK), solution of 0.3% NaCl Treatment (T1), magnetized solution of 0.3% NaCl Treatment (T2), solution of 0.5% NaCl Treatment (T3), magnetized solution of 0.5% NaCl (T4), respectively. The above solutions were watered of 100 mL every day from three-leaf stage and before that stage groundwater was watered.

Preparation of magnetized water: filled the mineral water bottles of a unified specification of 600 mL with saline solutions, which would be magnetized 1h with the F-type conversion magnetized water meter (wrapped around 20 turns) produced by Jinan Yishui Tech. Dev Co., Ltd.

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Items and methods: The SPAD value of wheat leaf was measured with chlorophyll meter of SPAD-502 type on January 20, 25 and 30th, respectively. Each plant was measured three times and the average value taken as SPAD value.

Leaf soluble protein content was measured with the Coomassie Brilliant blue method (Hao *et al*., 2002).

Measurement of Catalase (CAT) and Superoxide Dismutase (SOD) activity: weighed 1.5g samples and cut them into pieces to a mortar, adding 15mL phosphoric acid buffer solution of 150 mM/L, pH of 7.0, grinding on the ice bath, centrifuged 5 min at 15000 r/min to gain a crude enzyme extract which was the supernatant liquid part. SOD activity was measured with the method of Giannoplitis (Giannopolitis and Rise, 1977; Wang *et al*., 1983). CAT activity was measured in the method of UV absorption.

All the data were processed by using EXCEL and analyzed with the Date Processing System (DPS).

RESULTS AND ANALYSIS

Effects of magnetized saline on SPAD value of winter wheat: From Fig. 1, the overall SPAD value tended to increase and the sequence was T1>T2, T3>T4. The measurement results of January 20th showed significant differences and treatment CK the lowest SPAD value. It Indicated that during the early salt stress, the salt tolerance of the wheat was very weak and its growth was inhibited with the slowly growth of leaves which turned more green and higher SPAD value; SPAD value of the magnetized saline solution treatment was lower than saline solution treatment, indicating that magnetized saline was conducive to reducing the growth inhibitory effects of salt stress on wheat.

Effects of magnetized saline on growth of winter wheat seedlings: Table 1 showed that the plant height, root length, shoot fresh weight and root fresh weight of different treatments were different and the indicators of the magnetized saline solution treatment were higher than saline treatment. Measurement results on January 30th: plant height of T2 was 1.27 cm higher than T1; root length increased by 2.58 cm and shoot fresh weight increased by 0.05 g and root fresh weight increased by 0.07 g. The results showed that magnetized saline solution treatment was conducive to promoting the growth of wheat seedlings and increasing the salt tolerance of winter wheat.

Effects of magnetized saline on soluble protein content of winter wheat leaves: In Fig. 2, the soluble protein content of winter wheat in all treatments showed a first increasing and then declining trend. Measurement results on January 20th showed the soluble protein content as follows: treatment T2 was significantly higher than T1, treatment T4>T3 and treatment CK was significantly lower than the other treatments; measurement results on January 25th showed that the treatment T2>T1, T4>T3 and the differences were significant; on January 30th, T3 was significantly higher than other treatments and T4 was significantly lower than other treatment and soluble protein content of CK, T1 and T2 was lower than that in the 25th and the differences were not significant. The results showed that the early salt stress was conducive to the synthesis of wheat soluble protein, but the synthesis of wheat soluble protein was inhibited under too long time salt stress; the wheat soluble protein content of magnetized saline solution treatment was higher than the saline solution treatment.

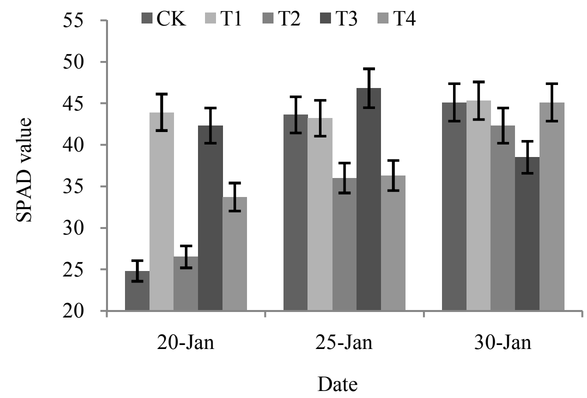

Fig. 1: Effects of magnetized saline on SPAD value of winter wheat

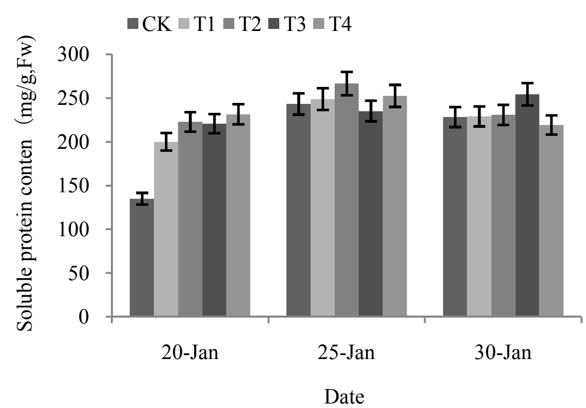

Fig. 2: Effects of magnetized saline on soluble protein content of winter wheat leaves

Effects of magnetized saline on SOD activity of winter wheat: From Fig. 3, the SOD activity of wheat showed a gradually increasing trend in the whole growth. Activity of SOD in wheat of control treatment was significantly higher than the other treatments; SOD activity of wheat in magnetized saline solution treatment was significantly higher than groundwater solution of the same salt concentration treatment. In the same period, specific performance of the activity

Table 1: Effects of magnetized saline on growth of winter wheat seedlings

	January 20th				January 25th	
Treatment	Plant height (cm)	Root Length (cm)	Shoot fresh weight/g	Root fresh weight/g	Plant height (cm)	Root Length (cm)
CK	27.8Aa	28.2Aa	0.490Aa	0.180Aa	32.79Aa	35.27Aa
T1	29.5Bb	30.72Bb	0.440Aa	0.240Aab	30.38Bb	33.8Bb
T2	27.7Bb	28.05BCb	0.47ABa	0.11ABbc	30.05Cc	33.67Bb
T3	27.75Bb	28.14CDc	0.48ABab	0.160Bcd	27.9Dd	29.43Cc
T4	27.67Bb	28.03Dc	0.3700Bb	0.090Bd	28.75Ee	30.86Dd

	January 25th		January 30th			
Treatment	Shoot fresh weight/g	Root fresh weight/g	Plant height (cm)	Root Length (cm)	Shoot fresh weight/g	Root fresh weight/g
CK	0.430Aa	0.87Aa	33.6Aa	39.6Aa	0.97Aa	0.95Aa
T1	0.340Aa	0.61Bb	31.23Bb	35.23Bb	0.84ABab	0.69Bb
T2	0.420ABab	0.67BCbc	32.5Cc	37.81Cc	0.89ABbc	0.76Bb
T3	0.230ABbc	0.53BCc	28.35Dd	33.35Dd	0.75Bc	0.61BCb
T4	0.290Bc	0.55Cc	30.51Ee	36.5Ee	0.79Cd	0.72Cc

Uppercase letters represented significant differences at p<0.01 level and lower case letters represented significant differences at p<0.05 level

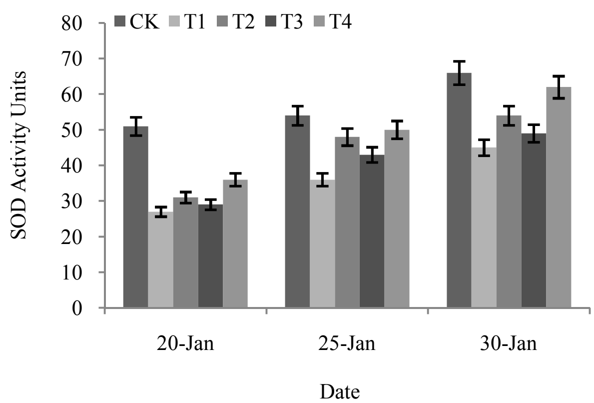

Fig. 3: Effects of magnetized saline on superoxide dismutase of winter wheat

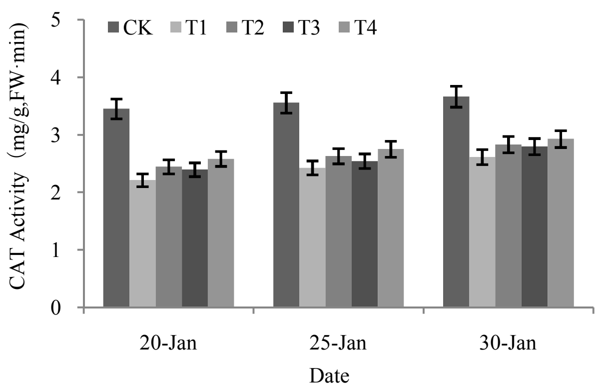

Fig. 4: Effects of magnetized saline on catalase of winter wheat

was in the following rules: treatment CK>T4>T2>T3>T1. The results showed that SOD activity of the wheat seedlings in magnetized saline solution treatment was significantly higher than that of the saline solution treatment.

Effects of magnetized saline on CAT activity of winter wheat: From Fig. 4, the wheat CAT activity presented a growing trend in the entire growth. CAT activity of wheat in the control treatment was significantly higher than other treatments. In the same period, the activity of CAT was in the following rules: treatment CK>T4>T2>T3>T1. The results showed that the saline solution treatment reduced the CAT activity of wheat and wheat in magnetized saline solution treatment had higher CAT activity than the saline solution treatment.

DISCUSSION AND CONCLUSION

The solubility, dissolved oxygen, osmolarity, conductivity, surface tension and so on of magnetized saline all improve obviously to promote the metabolism of living organisms. The enzyme of CAT and SOD are the adversities protease for body's resistance to adverse environment. CAT and SOD is scavenger of superoxide anion radicals which is harmful to the body, gaining lower accumulation of superoxide anion radical in the body under adversity stress.

However, there were some differences in the study of the biological effects of the crops for the magnetized water. Some researchers believed that (Hao *et al*., 2002), magnetic water treatment had no significant biological effects on seed germination and seedling growth. Other researchers believed that the low intensity of magnetized water could promote germination and early growth of soybeans, maize and rice (Qiu *et al*., 2011). Other researchers believed that the effect of drip irrigation in magnetized water was significant in de-salinization of soil and magnetized water could enhance the resistance of crops to improve the ability of the alkali salt resistance of crops with higher yield (Wang *et al*., 1983; Xie, 2010). Related debates are due to the different physical and chemical properties of the water caused by the magnetic flux density, magnetization time and by the number of the magnetic field, the magnetization of magnetized water placement and different water quality (Chibowski *et al*., 2003).

This experiment confirmed that wheat in the magnetized saline solution treatment had lower SPAD value, higher soluble protein content and higher activity of SOD and CAT than wheat in saline solution treatment which showed that under this experimental condition, the magnetized saline increased the salt tolerance of wheat and promoted the growth and development of wheat.

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