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Effect of Sodium Silicate on the Yield and Yield Components of Pea under Salinity Stress

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ABSTRACT: The reduction comes into operation. In this regard, one of the elements that can improve plant water status, salinity effects amend the silicon. To this end, the experiment was conducted in a completely randomized design with three replications Elam. Treatments include soil salinity levels 2, 4 and 6 dS/m sodium silicate with three levels, 1 and 2 mM, respectively. Results showed a significant effect of salinity on the number of pods per square meter, number of seeds per square meter, seed weight, seed yield and dry matter, so increasing salinity levels lead to a decrease in the value of this attribute. The lowest seed yield in salinity 6 dS/m amounts to 41.4 gram per square meter respectively. Silicon is also a significant effect on the number of pods per square meter, seed weight and grain yield. With consumption of 2 mM sodium silicate, yield to 99.7 grams per square meter. Based on the results of the silicon can be used to improve the yield and yield components of pea under salinity may be recommended.

Keywords: Peas, salt, sodium silicate, seed weight, dry weight

INTRODUCTION

Beans, meat, poor people, the second largest source of human food and cereals are the major source of vegetable protein. They are about 2 to 4 times the amount of protein in cereals and tuber plants is 10 to 20 times. Forage crops due to 8 to 14 percent protein, have more energy than is corn (Majnoon-Hosseini, 1993). Pea (*Cicer arietinum* L.) second most important crop of the most important cereal crops in the Middle East and Iran (Jamshidi *et al,* 2007). With high quality protein and a major role in increasing soil nitrogen. In most areas of the plant traditionally grown in rotation with cereals (Dashti *et al,* 2005). Compared to other crops from cultivation, production is more important; however, its sensitivity to salt it has a negative impact on growth and performance (Dashti *et al,* 2005; and Datta and Dayal, 1991).

Salinity, a major environmental stress and a barrier to production is desirable. Salinity characteristics - the physiology, morphology, anatomy, chemical composition and water content of plant tissue is affected. The effect of the type of plant, mineral composition, soil texture and structure, and even irrigation depends. Crop tolerance to salinity is a genetic trait that is controlled by a set of genes. For this reason, different plants with different mechanisms respond differently to salinity (Dashti *et al,* 2005). Saline soil accumulation of soluble salts of anions such as chloride, sulfate, bicarbonate, and sometimes nitrate and sodium cations, calcium, magnesium and potassium rarely is achieved in non-saline soil.

These ions are involved in the occurrence of salt. In the meantime, chlorides such as sodium chloride and sulfates such as sodium sulfate, the solubility, may play an important role in causing damage to the plant (Mirmohammadi and Ghareyazi, 2002).

Effect of salinity in arid and semiarid regions is striking. Hence, the lack of water and lack of proper management of soil salinity problems to multiply increases. Some non-essential minerals may help counteract the effects of salinity. For example, silicon is an element essential for plant growth, studies have shown that silicon application significantly increased plant growth under saline conditions (Taher *et al,* 2006). Many plants are able to absorb silicon absorbed by plant species 10-1/0% of the plant biomass is variable. This element can reduce evapotranspiration, increased resistance to salt stress, drought and heavy metal toxicity, irritation increased production of antioxidant enzymes and reduced susceptibility to some fungal diseases and thereby improve the quality and quantity of the product (Taher *et al,* 2006).

Research suggests that the elements Si, including its positive effects may be relieved by the risk of salinity (Epstein, 1999). By increasing the mechanical strength of silicon in plant resistance against bacteria, fungi and insects is reduced physiological disorders. Si application increased salt tolerance in barley, rice, wheat, tomatoes and cucumbers have been reported. (Peyvast *et al*, 2008).

Salinity affects the vegetative and reproductive growth of the plant, thus reducing the plant is dry. Salinity also reduces the production of dry matter in the atmosphere has a number of plants (Munns *et al*, 1982). Also, in experiments by other researchers who expressed high levels of salinity in alfalfa shoot dry weight is reduced. Researcher's beans under salt stress reduced plant performance can be observed (Katrjy *et al*, 1992). When the plant enters the reproductive stage salinity can be most effective in achieving yield disrupt processes (Zidane and Malibari, 1993).

Salinity, the effect on yield, yield is reduced. Salinity accelerates the terminal bud and the total number of spikelets per spike and number of grains of wheat declined. The researchers also believe that in this time of stress and ultimately reduce the amount of active pollen, pollen count, reduced fertility and seed filling (Alamgir *et al*, 1992). Results of some studies also indicated a positive impact on yield of silicon is used. Effect of fertilization with silicon Liu et al and reducing greenhouse cucumber disease showed an increased rate of disease increase cucumber yield was reduced silicon via (Liu *et al*, 2004). Liang and colleagues (2005) stated silicon used to increase the yield of corn. The results Peyvast *et al* (2008) on the interaction of different levels of salinity on the growth of silicon and silicon lettuce bolts showed that the effect on total plant dry weight and percentage dry matter at the 1% level, number of leaves, fresh weight and dry leaves and whole plants were significant at the 5% level. Zhu *et al* (2004) observed that dry and fresh weight of cucumber under salt stress decreased with the addition of silicon deficiency significantly improved. The use of silicon in wheat under saline conditions, shoot dry matter production increased significantly (Ahmed *et al*, 2005).

Therefore, the aim of this study was to investigate the effect of sodium silicate on the yield and yield components of chickpea under salinity stress was induced by sodium chloride.

MATERIALS AND METHODS

In order to determine the effect of different salinity levels on yield and yield components of chickpea, a pilot in the fall of 2013 in Ilam greenhouse in a factorial randomized complete block design with three replications. Treatments consisted of three levels of soil salinity, 2, 4 and 6 dS/m sodium silicate with three levels, 0, 1 and 2 mM. Amounts of lime-soda and salt together in solution at various levels of calculation and the field capacity moisture content, the soil was thoroughly mixed into the pan.

Watering pot according to field capacity each day, the water was not salty. In order to disinfect seeds and avoid possible fungal infections, the seeds for two to three minutes were hypochlorite, then rinsed with distilled water and tap water was. To perform this test, the pots with a diameter of 25 cm and a height of 25 cm was used. For drainage in the bottom of the pot, the pot size and placement of the holes were filled with soil. Crop was at a depth of 2 cm above the soil surface. Soil intended to apply in pots was passed through a sieve of 4 mm. 5 kg of dry soil for each pot was calculated. Amounts of sodium silicate and salinity levels, calculated with a solution of the field capacity moisture content, the soil (in the pan) was thoroughly mixed. This was done separately for each treatment and then pot the final weight gained (Sayyari-Zahan *et al*, 2009).

To determine the dry weight of the shoot, shoots from the soil level and temperature of 75°C oven for 48 hours, were placed. Then, carefully weighing them by laboratory scale 0.001 g was used. In this survey, also all plants in each pot and the number of seeds in each pot and harvested pods were counted. Then, the area of each pot and plant, number of seeds and number of pods per square meter was reported on. After separating the seeds from the pods as well as all the weight calculation, based on seed weight were reported. After calculating the weight of seed per pot, depending on the area of each pot and plant density on grain yield per square meter were reported.

In the end, after ensuring normality of the data, analyze them using statistical software SAS (version 8), LSD mean comparison method and the significance level was 5%. Graphs and Tableures were drawn by Excel 2007 software.

RESULTS AND DISCUSSION

Result will become some of the study showed that salinity had a significant effect on all traits included men pods per square meter, number of seeds per square meter, seed weight, seed yield and plant dry matter. Sodium silicate is also a significant effect on the number of pods per square meter, seed weight and seed performance (Table 1).

Table 1: Mean squares of analysis of variance of salinity and sodium silicate on the pea plant traits.

SOV	df	Number of pod per square meter	Number of seed per square meter	100 seeds weight	Seed yield per square meter	biological yield per square meter
Si	2	2345 **	563.4 *	176.8 *	199.56 *	756.4 ns
Salinity	2	198654 **	2156.5 *	678.4 **	5674.3 **	18765.4 **
Salinity *Si	4	456.3 ns	31.43 ns	1.645 ns	18.3434 ns	197.5 ns
Residual	18	234.67	235.8	3.56453	56.45443	367.2
CV (%)	-	8.32	7.34	4.34	9.1	14.5

*,ns and **: respectively no significant, significant in probable level 5 and 1 percent

Table 2: Compotation of mean the effect of salinity and Si.

Biological yield per square meter	Seed yield per square meter	100 seeds weight (g)	Number of seed per square meter	Number of pod per square meter		
155.5 a	92.4 a	45 a	102 a	88 a	2	Salinity (ds/m)
124.4 b	63.7 b	36 b	69 b	70 b	4	
98.2 c	41.4 c	31 c	47 c	34 c	6	
139.6 a	76.5 c	39 c	85 c	78 c	0	Si (mM)
145.6 a	88.4 b	41 b	94 b	94 b	1	
158.5 a	99.7 a	46 a	103 a	101 a	2	

Related to each treatment in each column, means with common letters no significantly different by Duncan test at 5% level whatsoever.

Results showed that the highest number of pods per square meter in salinity of 2 dS/m to the 88 values were calculated relative to the highest levels of salinity significantly increased 1.8 times (Table 2). Parande (2012) stated that research on beans, salt stress induced by sodium silicate pods per square meter is reduced significantly. Lowered salinity during the growing season, resulting in a reduced number of pods per plant. The most sensitive part of pod yield and yield components of environmental stresses on the reproductive phase formed earlier show greater response to stress (Parande, 2012). The researchers stated that the reduction in soybean pods associated with increased stress hormone ABA plant is pollinated when pollen death (Liu *et al,* 2004).

The effect of silicon on the highest number of pods per square meter of 2 mM, the amount of silicon 101 numbers are obtained, the 33% increase relative to the control (Table. 2). Parande (2012), research on beans stating that compared to non-consumers of sodium silicate led to a significant increase in the number of pods per square meter was. Fatemi *et al* (2009) stated that the presence of silicon in the nutrient solution increased plant developmental characteristics, performance indicators will increase

Results showed that the highest number of seeds per square meter, the salinity of 2 dS/m value of 102 was obtained with the highest level of salinity increased significantly compared to the equivalent of 2.12 times (Table 2). The researchers stated that the effect of salinity on yield components, yield decreases with increasing salinity and yield components such as number of grains per spike is reduced (Solomon *et al*, 1994). Zidane and Malybary (1993), reduced yield under salt stress were reported and expressed bean plant when the plant enters the reproductive stage, the salinity can affect many processes in achieving yield, including the number of grains disrupt. Parande (2012), quoted by other researchers reduced the number of grains of chickpea under salinity stress on the log.

Increased salinity reduced 100 seeds weight of the peas. The highest seed weight, the lowest level of salinity the value of 45 g, respectively, compared to EC 6 dS/m showed a 46% increase (Table 2). Zidane and Malybary (1993), a significant reduction in wheat grain yield at high levels of salinity were reported. Disruption to transport grain carbohydrates may be the most important reason for the reduction of grain yield under drought conditions. Also, grain weight, grain filling period shall be determined by lot. Thus, environmental stresses that have a tendency to shorten the grain filling significantly reduce grain yield.

Silicon effect on these parameters, the highest seed weight by consuming 2 mM silicon in the 46 g achieved that 28% increase compared to the control treatment (Table 2). Parande (2012) reported an increase in seed weight silicon consumption of beans. Matsue and colleagues on the reduction of grain filling and seed maturation in terms of silicon deficiency stressed (Matsue *et al*, 1995).

Increasing salinity reduces yield of pea seeds were awarded. The lowest yield, the highest salinity level (6 dS/m) to the 41.4 grams per square meter, respectively, compared to 45 percent decrease in salinity of 2 dS/m (Table 2). Increased salinity, plant growth and nutrient content of the plant decreases. Thus reducing the osmotic potential due to reduced vegetative growth, reproductive growth and ultimately yield are influenced by salinity. Saline conditions, leading to reduced water absorption, reduced transpiration and stomatal closure, which is leading to reduced growth (Taher *et al,* 2006, 2006), therefore, appears to reduce the loss of vegetative growth reproductive growth and yield have been. Parande (2012), quoted by other investigators stating that salt stress leads to a reduction in cereal is like beans and peas.

Silicon effect on these parameters, the maximum grain yield, taking the value of 2 mM Si 99.7 mg achieved a 32% increase compared to the control treatment (Table 2). Parande (2012) showed that the silicate fertilizers affect plant growth and increased biomass production and soil fertility by reducing transpiration, resulting in higher yield will be. Parande (2012), increasing the yield of different crops including cereals reported with the use of sodium silicate.

Increased salinity, reduced biological yield was peas. Lowest biological yield, the highest salinity level (6 dS/m) to the 98.2 grams per square meter, respectively, compared to 52 percent decrease in salinity of 2 dS m (Table 2). Findings and Naseer (2001) showed that increasing salinity decreased the dry weight of pea seedlings have been. Seedling dry weight loss can be caused by increased energy conservation and reduced energy availability for development (Naseer *et al,* 2001).

The results echo findings (2004) is consistent with the peas. One of the effects of salinity, loss of dry matter due to the reduction in plant height. However, shoot dry weight under salt stress more than other organs decreases (Stribley, 1987). Hossain *et al* (2008), a significant decrease in the number of green leaves, fresh and dry weight of cowpea plants with rootstocks reported particularly high levels of salinity. Mirmohammadi Meybodi and Nagorno mathematics (2002), have reported reduced stem length in salty conditions. They stated that it would reduce the weight and stem dry matter accumulation is reduced.

According to the results of the experiment, increased salinity reduces yield components of chickpea was unnoticeable. In this study, silicon reduces the adverse effects of salinity on yield components in chickpea. As of 2 mM silicon increases seed weight, number of pods per square meter and grain yield.

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