Study of potassium and sodium silicate on the morphological and chlorophyll content on the rice plant in pot experiment

(Oryzasativa L.)

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ABSTRACT: Silicon is one of useful element for rice growth which is very important for the plant because of it is morphological and physiological characters. In order to study the effects of silicon on the morphological and physiological characters, we placed the provided seed in a pot after sterilization. Then, we planted the seeds in pots of three piles each one consisting four seeds. We considered the effects of silicon in the case of sodium and potassium silicate at three different levels (0,50 and 100ppm) with a repeat of three times for each experiment. This study indicated that in the tiller stage the concentration of silicon in stem and leaf tissue will increase of silicon level. Analyzing the average of seeding indicated that the increase of sodium silicate levels caused on enhancement on plant height, tiller number leaf area and total dry weight. Also, with the increase of potassium silicate levels in stem and leaf tissue, and had a positive effect on morphological characters in tiller stage. Also in flowering stage with increasing the levels of sodium and potassium silicate fertilizers the amount of chlorophyll a,b and total chlorophyll increased, that this increase is meaningful by 5%.

Keywords: chlorophyll, potassium and sodium silicate, rice, Morphological characters

INTRODUCTION

Silicon is one of the most available elements of the earth crust which is appeared in different compleions (Fallah, A. 2000). In the early nineteen century, it was believed that this element was really beneficial for rice and now it is believed that this element is essential for rice cultivation because of it is positive effects (Epstein, E, 1994, Takashi et al 1990). Most beneficial effects from silicon are realized through the formation of silica gel, which is deposited on the surface of leaves, stems and other organs of plants (Takashi, E, Miyake, Y, 1997). The uptake of silicon from soil solution takes place in the form of mono silicic acid which is named "orto silicic". The great amount of silicon available in the rice is really important for the growth of silicon causes both the growth and increase of dry production (Datnoff L et al 1997). It decreases cuticle perspiration and increases biomass, tiller number spikelets, seed weight and decrease susceptibility to disease and insect damage, prevent lodging and all evict water and various mineral stress (Isris et al 1975, Ma, J.F, 2002, Agarie et al., 1996, 1993). Matsoet al (1995) believe that silicon uptake strengthens. Without silicon, the growth of rice is negative affected. The productivity decreases greatly due to reduced fertility (Elawad et al 1982. Ma et al 2002). Silicon causes to changes in the amount of carbohydrate and proteins of plant tissue because silicon the increase of plant height, tiller number and leaf number and leaf area (Ma J.F2003). Using silicon has a positive effect over each panicle branch. Datnoff(1991) cited that increases the growth and function. One important role of silicon is two form and mix the perimeter of lignin and carbohydrates through cooperating fonolic acid and aromatic rings that causes mechanical strength of layers, vertical position of the leaves and their stability (Rani et al 1997, Ravent J.A. 1983). Vertical position of the leaves and their stability causes the disappearance of the higher leaves shadow from lower ones and the greater surface of the leaf exposes the sun and therefore causes the exchange of CO2 and the enhancement of the leaf photosynthesis (Inanaga et al 1995, Korndorfer G.H, Lepsch I 2001). When the amount of silica goes down, attracting carbon dioxide is blocked so the penetrates will be closed and photosynthesis outcome will be decrease (Fallah A. 2000). Agarie in 1993 showed that if the amount of silicon be short the amount of chlorophyll and
photosynthesis will decrease. Silicon has an important effect on photosynthesis chain and prevent from chlorophyll chain. Quanzhi and Erming (1998) in 1998 believed that silicon cause to leaf broadcasting so it concludes to photosynthesis improvement. Youshida (1975) and his partners surveys showed that the cells of area epidermis of rice leaf has a silicon layer along with cellulose which is under the cothycle. These researchers confirmed on silicon extra layer in limitation of unnecessary exit of water and prevention of fungi mycelium penetration (Yoshida et al. 1976, Yoshida S. 1975).

MATERIALS AND METHODS

In order to study of potassium and sodium silicate effects on some morphological and physiological characters on the rice in pot condition. This experiment was conducted at 2008 in research institute of Iran (Amol). To perform this experiment, the vases with soil composition in the form of clay with PH=7 and electrical leading of 1.36 DC2/M with a carbon percentage of 1.68 have been applied. To study the effect of silicon, potassium silicate and sodium silicate fertilizers have been applied at three different levels of (0, 50 and 100ppm). Statistic plan in a factorial from work has been performed accidentally in pot condition. Totally 18 pots have been used. To analyze the give information, SAS software and Excel were used. To disinfect the seed, we first disinfected the seeds by using sodium hydrochloride and antimould binomial 2/1000 solution per 30S and among each stage of infection; we washed the seeds with fresh water. After disinfecting the seeds, we replaced them into a tub to store them. Then, we planted the growth seeds in pots of three piles, each pile consisting four of them. We labeled the vases by the kind of their planting and in this case the exact levels of planting were recognized. At the growth stage (maximum rate of tiller), the height of the plant, the number of the tiller and the leaf area were measured by using leaf area value meter(cm²/hill). The separated leaves of each plant sample entered the machine and in this case the number marked by it indicated the leaf area in square meter. To measure the amount of silicon in stem and leaf tissue of rice, Youshida method has been applied in 1976. First, we left the stems and leaves related to each growth for 24 hours to get dry at a temperature of 75°C. Then, we milled the samples and then mixed one gram of each of them with acid (nitric acid, sulfuric acid, chloridric acid). Then, we put the staples into a hood. After that we put them on hot plate at a temperature of 250°C-350°C for four hours until they get a color of milk-white. We washed those samples consisting 2 mil/liter of milk-white solution with 20mil/liter of fresh water until it is components pass through filters paper over the flask. We end this clear passage of washing with one tenth of chloridric acid 10 mil/liter. Then we put the original filter paper into the beaker and then replaced it to the electrical oven at a temperature of 450°C for four hours. Then we put those beakers containing silicon into petridish to weigh them accurately with accurate scales. In flowering stage chlorophyll amount measured. To do this, we weigh 1gram leaf and rubbed it in acetone 80% solution as after this step there was no green spot on leaves, after leaching the solution fir 5 minutes. Centrifuged in 3000 r/s. After separating 2 concluded part from centrifuge we separate the upper solution and read the absorbed spectrums during the waves 645,652,663 by spectrophotometer.

RESULTS AND DISCUSSION

At the stage of maximum tiller, meancomparing average indicated that the effect of sodium silicate on the number of tiller has an increasing out come on plant height, the number of tiller and leaf area and this increase was based on a real situation. By increasing of sodium silicate consistency in leaf and stem issue, silicon in leaf and stem issue in 1% layer was significant (table 1). With the increase of silicon levels, we see an enhancement in dry weight, that this trend is not significant (tables 1, 2).

Table 1. Effects of sodium silicate on the morphological characters in tiller stage.

<table>
<thead>
<tr>
<th>Silicon (ppm)</th>
<th>Height (Plant(cm))</th>
<th>Tiller number</th>
<th>Leaf Area(cm²/hill)</th>
<th>Stem dry Weight (gr/hill)</th>
<th>Leaf dry Weight (gr/hill)</th>
<th>Total dry Weight (gr/hill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>68.05a</td>
<td>12.55b</td>
<td>571.58b</td>
<td>3.41a</td>
<td>2.44a</td>
<td>5.85a</td>
</tr>
<tr>
<td>50</td>
<td>68.50a</td>
<td>14.55a</td>
<td>625.96a</td>
<td>3.41a</td>
<td>2.58a</td>
<td>6a</td>
</tr>
<tr>
<td>100</td>
<td>70.27a</td>
<td>14.77a</td>
<td>659.82a</td>
<td>4.06a</td>
<td>2.76a</td>
<td>6.83a</td>
</tr>
</tbody>
</table>

For each parameter, means followed by different letter (within a column) are significantly different at 0.05 probability level according to DMRT
Table 2. Effects of potassium silicate on the morphological characters in tiller stage.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Silicon(ppm)</th>
<th>Height Plant(cm)</th>
<th>Tiller number</th>
<th>Leaf area(cm²/hill)</th>
<th>Stem dry weight(gr/hill)</th>
<th>Leaf dry weight(gr/hill)</th>
<th>Total dry weight(gr/hill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>69.33b</td>
<td>11.77b</td>
<td>591.11a</td>
<td>4.07a</td>
<td>2.76a</td>
<td>6.84a</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>71.77a</td>
<td>12.88a</td>
<td>617.91a</td>
<td>4.22a</td>
<td>2.96a</td>
<td>7.18a</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>73.11a</td>
<td>13.55a</td>
<td>639.37a</td>
<td>4.91a</td>
<td>3.15a</td>
<td>8.06a</td>
</tr>
</tbody>
</table>

For each parameter, means followed by different letter (within a column) are significantly different at 0.05 probability level according to DMRT.

In 1995, Matsuo and his colleagues suggested that silicon causes the growth of the plant and therefore increase the amount of dry productions. With the increase of silicon levels, the height and the number of the tiller will increase. Youshida et al (1976) believed that silicon causes the vertical position of the leaves. Snyder et al. (1986) suggested that silicon increases that height of the plant and cause tiller. Raventet al. (1983) believed that the plant height will be increased by using materials consisting silicon. Silicon by setting over the cell walls together with lignin can be effective over the dry weight. In 1993, Agarie and his colleagues by studying the ten samples of different rice cultivations suggested that with the increase of silicon fertilizers, the dry weight of the plant will increase together with it is height. It has also been shown that it has the greatest effect over the "suween". Because, the leaf area and tiller number were increased with the enhancement of silicon levels. This increase was based on a real situation of 5% (6). Average comparison showed that by increasing of sodium and potassium silicate fertilizers, the amount of chlorophyll a,b and total will increase (tables 3,4). In a way that the effect of sodium silicate fertilizer on raw chlorophyll amount on level 1% and the effect of potassium silicate fertilizer on level 5% was significant respectively.

Table 3. Average comparison of chlorophyll content in different levels of potassium silicate in flowering stage.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Silicon(ppm)</th>
<th>Chl(a)(mg)</th>
<th>Chl(b)(mg)</th>
<th>Total Chl(mg)</th>
<th>Chl(a)/b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0.058b</td>
<td>0.031b</td>
<td>0.068b</td>
<td>1.89a</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>0.06b</td>
<td>0.039a</td>
<td>0.107a</td>
<td>1.79a</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.070a</td>
<td>0.043a</td>
<td>0.111a</td>
<td>1.47a</td>
</tr>
</tbody>
</table>

For each parameter, means followed by different letter (within a column) are significantly different at 0.05 probability level according to DMRT.

Table 4. Average comparison of chlorophyll content in different levels of sodium silicate in flowering stage.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Silicon(ppm)</th>
<th>Chl(a)(mg)</th>
<th>Chl(b)(mg)</th>
<th>Total Chl(mg)</th>
<th>Chl(a)/b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0.036b</td>
<td>0.03b</td>
<td>0.068b</td>
<td>1.30a</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>0.037b</td>
<td>0.031a</td>
<td>0.070b</td>
<td>1.31a</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>0.080a</td>
<td>0.049a</td>
<td>0.111a</td>
<td>1.29a</td>
</tr>
</tbody>
</table>

The investigations express that the decrease of silicon cause to decrease of absorption of dioxide carbon and block the hatches. Since silicon has an important role in leaves stability and able to expose more leaves to light so, it cause to increase of plants canopy photosynthesis efficiency (Quanzhi Z, Erming G. 1998). In 1998 Quanzhi found that silicon can cause leaf development and can cause improve photosynthesis. Agarie et al (1993) showed that silicon has a significant effect on photosynthetic rate and prevent the destruction of chlorophyll. Silicon also increased leaf area extends, that cause make more light available for photosynthesis implement. In these experiment was determined silicon shortage can cause reduce the amount of chlorophyll (Agarie S. 1993).

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