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Impact of Potassium Silicate Compound as Foliar Application on the Growth, Yield and Grains Quality of GIZA 179 Rice Cultivar.

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of Rice Research Department (R.R.D.), Sakha, Kafrelsheikh, Egypt during 2015 and 2016 seasons. In order to examine the impact of potassium silicate compound as foliar application on the growth, yield and grains quality of Giza 179 rice cultivar. A randomized complete block design (R.C.B.D.) with four replications was used in the two seasons. Foliar applications of potassium silicate, at the rate of control (without potassium silicate), 0.5%, 1.0%, 1.5% and 2.0 % potassium silicate were sprayed twice with the same concentration at 15 and 30 days after transplanting. The studied characters were; chlorophyll content in flag leaf, leaf area index, dry matter accumulation, plant height, no. of tillers per m^2, no. of panicles per m^2, panicle length cm, panicle weight g, total no. of grains per panicle, thousand grain weight, grain yield ton/ha, percentages of hulling, milling and head rice and silicon content in stems, grains and straw .The results showed that application of potassium silicate caused an increased in growth characters, yield, yield attributes and grains quality of Giza 179 rice cultivar. Potassium silicate at the rate of 1,0% produced the maximum values of chlorophyll content in flag leaf, leaf area index, dry matter accumulation, plant height, number of tillers/m^2, number of panicles/m^2, length of panicle (cm), weight of panicle (g), grain yield(ton/ha), as well as, hulling, milling, head rice percentages of Giza 179 rice cultivar, while sprayed Potassium silicate at the rate of 1.5 % resulted the maximum total number of grains/panicle and the rate of 2.0% produced the maximum silicon content in stems, grains and straw. All the other parameters showed overlapping results of different potassium silicate levels. According to the previous results, it could be concluded that using potassium silicate as foliar application twice with the same concentration 1.0% at 15 and 30 days after transplanting was the best treatment for improving growth and obtaining the greatest grain yield besides the grains quality of Giza 179 rice cultivar.

Keywords: Rice, silicon, potassium silicate, foliar application, Yield, Quality and Silicon content.

INTRODUCTION

In Egypt rice occupies an important place in cereal crops which ranked second after wheat also, considered the most important and major food grain for more than a third of the world's population so to meet the consistent demands from this crop should must Increasing the productivity per unit land area and makes it as a native goal. Rice crop have a conspicuous position in the agricultural economy which required improving the yield, grains quality characters and the quality of the elements nutrition. It is known that rice plants accumulate the silicon (Takahashi et al., 1990) and from silicate nutrition the rice plant is benefited (Yoshida, 1975 and Takahashi, 1995). Consequently many researchers consider silicon as an agronomically essential element which defined need for increasing besides sustaining rice production (Takahashi and Miyake, 1977 and Yoshida, 1981). In Japan, the silicate recognized the first fertilizers and 1.5 tons to 2.0 tons per hectare of silicate fertilizer have been applied to paddy soils consequently resulted in increasing the rice yield by 5 to 15 percent these results reported by (Takahashi et al., 1990). Potassium silicate has several potential benefits consequently its sufficient supply is required for healthy growth and productive development of the rice crop and maximizes the grain yield. Potassium silicate is responsible for improved growth characters in rice plants and the potential to improve their agronomic performance and efficiency in terms of yield response. (Kang, 1985) also, observed that foliar spray of 100 to 400 ppm silicon applied twice to rice seeding at the booting stage increased tillering capacity, improved vegetative growth consequently increased dry matter yield and hastened heading and photosynthetic efficiency. Silicate fertilizers important for sustainable and increasing the production of Basmati rice and the other types of rice. Concentrations of Silicon alone is consistently present at similar to those of the macro nutrients. The concentrations range from 0.1 percentages (similar to phosphorus and sulfur) to more than 10 percent of the whole plant dry matter in different plants especially rice plants (Epstein, 1999). Silicon hydrated amorphous compounds are likely in depositing in the different cellular parts such as; cell walls, cell lumens and intercellular spaces. The deposition below and above of the cuticle layer. In Asia, silicate fertilizer is an important micronutrient for competitive and healthy growth of all cereals especially rice crop (Brunings et al., 2009). Many researchers proved that adequate the uptake of silicon increase the tolerance of agronomic crops including rice plants to both abiotic and biotic stress and increase growth characters, yield and its attributes and grains quality (Ma and Takahashi, 2002). The deficiency of the silicon makes the rice plants more susceptible to; insect feeding, germs attack, fungal diseases and abiotic stresses which adversely affects on crop yield and grains quality. The effects of silicate fertilizers on the grain yield are related to the element deposition under the leaf epidermis which results a defense by the physical mechanism, increases the capacity of photosynthesis, decreases the transpiration losses and reduces the lodging of the rice plants (Korndörfer et al., 2004). The role of potassium silicate fertilizers in rice plant growth have been observed by many scientists and concluded that application silicon to plant develops the photosynthetic efficiency of the leaf, improves growth characters and produce more grain yield in crops cereal especially rice crop (Shashidhar et al., 2008). Silicon fertilizer has been considered important for improving vegetative growth and healthing development also the optimum amount of the silicon nutrition is necessary for cell development and its differentiation (Liang et al., 2005). Nitrogen, phosphorus and potassium as a major nutrients are already in practice at optimum level but yield gap is still present so following the recent research it is needed to enter nutrients like silicon (Si) as potassium silicate in rice production. In the light of above discussion present study was designed to investigate the effect of different concentration of potassium silicate applied as foliar spray on growth, yield and quality of Giza 179 rice cultivar.

MATERIALS AND METHODS

The field experiments were conducted at the Experimental Farm of Rice Research Department (RRD), Sakha, Kafrelsheikh, Egypt during 2015 and 2016 rice growing seasons to study the impact of potassium silicate applied as foliar spray on growth, yield and its attributes and some of the grains quality characters of Giza 179 rice cultivar. During the both studied seasons the previous crop was barley. The samples of the soil were taken randomly from the experimental site at the depth of 0 to 30 cm from the soil surface and both of chemical and physical analyses were done. The procedure chemical and physical analyses of the soil followed the methods which described by Black *et al.* (1965). Soil chemical and physical analysis of the experimental site during 2015 and 2016 seasons showed that Soil texture (%) was clayey with Clay percentage 57.00 and 54.00, Sand percentage11.00 and 11.00, Silt percentage 32.00 and 35.00, pH (1: 2.5 water suspension) 8.05 and 8.2, EC (dS/m) 2.0 and 2.05, Organic matter 1.65 and 1.50, Available Phosphorus mg / Kg 14.00 and 12.00, Available NH_4 mg/ Kg 13.5 and 12.60, Available NO_3 mg /Kg 10.0 and 11.80, Available K mg /Kg 366 and 350, Cations (meq/L.); Ca^{++} 7.20 and 6.00, Mg^{++} 2.60 and 1.50, Na^+ 12.00 and 13.00, K^+ 0.50 and 0.50, Anions (meq /L.); $HCO3^-$ 5.60 and 5.00, Cl^- 14.00 and 14.00, $SO4^{--}$ 2.70 and 2.00, CO3¯¯0.00 and 0.00 , respectively.

The experimental design:

The experimental design was randomized complete block design (R.C.B.D) with four replications. The assigned five treatments of potassium silicate (10% k_2o and 25% sio_2) foliar application used in this study were arranged as follows: (T_1), control (without potassium silicate application), (T_2), 0.5 % potassium silicate, (T_3), 1.0% potassium silicate, (T_4),1.5% potassium silicate, (T_5), 2.0% potassium silicate. The foliar of potassium silicate compound applied twice with the same concentration at 15 and 30 days after transplanting (DAT).

Nursery and preparation:

The nursery area was identified, ploughed and well dry leveled then, four kilogram calcium super phosphate (15.5% P_2O_5/175 m^2 land area) before ploughing, three kilogram urea (46.5% N/175 m^2 land area) was added after ploughing and one kilogram zinc sulphate ($ZnSO_4$) was applied after buddling (wet leveling). The other all culture practices were applied as recommended for the nursery. The seeds of rice, at the rate of 120 kg ha^{-1}, were soaked in fresh water for 24 hrs. and incubated for another 48 hrs. to hasten early germination. Pre-germinated seeds were uniformly broadcasted in nursery with 2 to 3 cm water depth on May 17th in 2015 and 2016 seasons. Weeds in nursery land were chemically controlled using Saturn 50% at the rate of 5 liters/ha (85 cm^3 / 175 m^2 land area) mixed with enough sand to make it easy for homogenous distribution and it was applied at seven days after sowing into 3 cm water depth. All other cultural practices were applied as the recommendation of the Rice Research Department.

The permanent field

The permanent field was prepared by twice plowing and harrowing then, the well dry leveling was done and light wet leveling was carefully made. Each plot of the experimental site was fertilized by the rate of 36 kg P_2O_5 per ha in the form of calcium super phosphate (15.5% P_2O_5) during the preparation of soil. One inorganic nitrogen 165 kg N ha^{-1} (urea 46.5% N) was applied in two split doses (2/3 as basal, 1/3 top dressing at 30 days after transplanting). The seedling at twenty five days old were pulled and transferred to the permanent field then, regularly transplanted at 20*20 cm distances between hills and rows (25 hills m^{-2}) in each plot. In both studied seasons two seedlings per hill in all plots were transplanted. The size of each plot was 12 m^2 (3m × 4m). Weeds were chemically controlled using Saturn 50% at the rate of 5 L/ ha and mixed with enough sand to make it easy for homogenous distribution. It was applied four days after transplanting into 3 cm water depth and kept without either flushing or irrigation until all the water in the field reach to the saturation to increase the efficiency of the herbicide to control weeds. The other usual cultural practices were conducted according to the recommendation of Rice Research Department (R.R.D., 2010).

Studied characters:

Growth characters were; Chlorophyll content in flag leaf (SPAD-Value), Leaf area index (LAI), Dry matter accumulation (g/m^2) at booting period, Plant height (cm) and No. of tillers per m^2 at 5 days before harvest.

Yield and its attributes characters were; No. of panicles per m^2 at 5 days before harvest, Panicle length (cm), Panicle weight (g), No. of total grains per panicle, No. of unfilled grains per panicle, Thousand grain weight (g) and Grain yield (t/ha).

Grain quality characters: Hulling, milling and head rice percentage were estimated according to the methods reported by Adair (1952).

Determination of silica (mg/g): The protocol for the measurement of silicon content was conducted according to the method described by Dai *et al.* (2005).

Statistical analysis:

The data were subjected to analyses of variance which described by Gomez K. and A. Gomez (1984) and all statistical analysis was performed by using "MSTATC" computer software package according to Russell F. (1986). The treatment means were compared by using Duncan's Multiple Range Test which described by Duncan D. (1955).

RESULTS AND DISCUSSIONS

Growth characters:

Represented data in Table 1 of chlorophyll content in flag leaf, leaf area index and dry matter accumulation at booting period of Giza 179 rice cultivar as influenced by foliar spraying of potassium silicate during 2014 and 2015 rice seasons revealed that chlorophyll content in flag leaf, leaf area index and dry matter accumulation were gradually increased by the application of potassium silicate percentage as compared with the control treatment. Spraying of potassium silicate at the rate of 1% produced the maximum values of chlorophyll content in flag leaf, leaf area index and dry matter accumulation. While, the greatest values of LAI, chlorophyll content and dry matter accumulation reached to the maximum when the tested cultivar was sprayed by any of the last three percentages of potassium silicate (1%, 1.5% and 2%) without any significant differences among them. These results were hold true in the two seasons with LAI and only in 2015 season with dry matter production. Potassium silicate improves the architecture of rice plants and cause the leaves erect more consequently increase the light utilization by the leaves of the tested rice plants, which generates an increase of the photosynthetic rate. The increased in photosynthetic rate causes an increase in NADP and NADPH as co-enzymes which increase the biological process a consequently higher nitrogen assimilation capacity and more dry weight accumulation (Taiz and Zeiger, 2010). The increase in potassium silicate levels resulted in a smaller opening of the erect leaf angle with the stem of rice plants. This effect madding the plants more erect and reduced the self-shading of lower leaves of the canopy (Deren et al., 1994), which made the plants more photosynthetically efficient and better able to exploit the space available to intercept solar radiation and also increasing their longevity . Interesting potassium silicate had favorable effect on rice growth, since it improve photosynthesis, reducing respiration and increased number of cell division and its elongation turn in good canopy resulted in high LAI which also led to increase photosynthesis process and dry matter production. Similar findings had been reported by Singh and Singh (2006) and Singh *et al.,* (2006).

Table 1. Chlorophyll content in flag leaf (SPAD-Value), Leaf area index and dry matter accumulation (g/m^2) at booting period of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Character	Chlorophyll content		LAI		Dry matter(g / m^2)	
Treatment	2015	2016	2015	2016	2015	2016
Potassium silicate %						
0 (without spraying)	36.17 d	35.41 d	4.318 b	4.453 c	640.80 c	571.32 d
0.5 %	37.29 c	36.56 c	4.714 ab	4.653 bc	683.10 b	628.02 c
1.0 %	42.31 a	41.20 a	4.939 a	4.888 a	726.30 a	670.95 a
1.5 %	39.03 b	38.81 b	4.795 a	4.810 ab	701.10 ab	662.49 b
2.0 %	38.77 b	38.06 b	4.733 ab	4.768 ab	694.80 ab	636.39 b

Means of plant height (cm) and number of tillers/m^2 of Giza 179 rice cultivar at 5 days before harvest as affected by foliar application of potassium silicate in 2015 and 2016 seasons are presented in Table 2. Data in Table 2 demonstrated that application of 1% potassium silicate as foliar spray recorded the tallest plants without any significant differences with 1.5 % and 2%, while, number of tillers/m^2 reached to the maximum values under 1% only. On the other hand the shortest plants and lowest number of tillers/m^2 were observed when rice plants didn't receive any potassium silicate spraying in both seasons of the study. Application of potassium silicate was effective in preventing lodging in rice by increasing the thickness of the culm and size of the vascular bundles thereby enhancing the strength of the culm. With regard to silicon levels, Si at 120 kg ha^{-1} (Sio_2) recorded the highest growth and yield of rice. This could be due to adequate silicon supply might have been improved the photosynthetic activity which enable rice plant to accumulate sufficient of assimilates which increased dry matter production (Rani and Narayanan,1994).The tested potassium silicate tightly ensure enough silicon, which play main role as soil amendments and growth improvement. The improving rice growth by potassium silicate might be increasing the growth activators releasing, resulted in acceptable plant height. Silica in the form of potassium silicate might be increased the bio-availability of nutrients and its uptake and improved rice growth by accelerating cell division and elongation which led to increase plant height. These results are in agreement with those reported by Arab *et al.* (2011), Li *et al.* (2011), Ali *et al.* (2012) and Ahmad *et al.* (2013).

Table 2. Plant height (cm) and number of tillers/m^2 five days before harvest of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Character	plant height (cm)		number of tillers /m^2	
Treatment	2015	2016	2015	2016
Potassium silicate%				
0 (without spraying)	94.16 c	92.80 c	488.12 e	492 83 e
0.5 %	95.93 b	94.34 b	504.08 d	507.25 d
1.0 %	97.89 a	96.84 a	580.17 a	582.75 a
1.5 %	96.70 ab	95.90 ab	553.92 b	558.63 b
2.0 %	96.62 ab	94.83 b	527.29 c	530 67 c

Yield and its attributes:

Data associated with number of panicles/m^2, panicle length (cm) and panicle weight (g) of Giza 179 rice cultivar as influenced by foliar application of potassium silicate in the two studied seasons 2015 and 2016 are listed in Table 3. In the two seasons significant differences in number of panicles/m^2, panicle length (cm) and panicle weight (g) were detected by varying potassium silicate percentages. Data documented that potassium silicate at the percentage of 1% produced the maximum number of panicles/m^2, tallest panicle (cm) and heaviest panicle in 2015 and 2016 seasons without any significant differences with the percentage of 1.5% in both seasons in panicle length and panicle weight. While, the minimum number of panicles/m^2, the shortest panicle (cm) and lightest panicle (g) were clearly obtained when rice plants didn't receive any potassium silicate spraying (control treatment) in 2015 and 2016 seasons**.** Applying potassium silicate sprays ensures and promotes panicle differentiation and primordial formation resulted high panicles number. The favorable impact of potassium silicate as foliar spray application might be attributed its increasing leaf water potential, bioavailability of nutrient, increasing antioxidant, elevated growth hormones and regulators, reducing transpiration rate, increasing photosynthesis rate, improving cell membrane stability, increasing energy compound and encourage cell division and elongation. Potassium silicate ensure high nutrient content turn in high content of Indole Acetic Acid (IAA), Gibberellic Acid(GA_3), which increased cell division and elongation of panicle axel resulted in long panicle. Furthermore, silica contractors the abundant Abscisic acid (ABA) release which inhibited panicle exertion by reducing panicle peduncle elongation and division. Applying silica might increase IAA and GA_3 formation while reduced ABA formation. The current findings are in a good agreement with those reported by **Arab et. al.(2011) and Dastan et. al. (2011).**

Table 3. Number of panicles/m^2, panicle length (cm) and panicle weight (g) of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Character / Treatment	number of panicles /m^2		Panicle length (cm)		Panicle weight (g)	
	2015	2016	2015	2016	2015	2016
Potassium silicate%						
0 (without spraying)	452.89 e	477.11 e	19.20 c	18.23 c	3.02 d	2.99 c
0.5 %	479.01 d	501.12 d	20.61 b	19.58 b	3.22 c	3.18 bc
1.0 %	570.37 a	574.36 a	22.00 a	21.12 a	3.73 a	3.55 a
1.5 %	546.92 b	547.33 b	21.69 a	20.84 ab	3.59 a	3.48 a
2.0 %	511.17 c	515.99 c	21.32 ab	19.77 b	3.39 b	3.32 ab

Data related to total No. of grains per panicle, No. of unfilled grains per panicle, 1000-grain weight (g) and grain yield (ton/ha) of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons are presented in Table 4. Concerning to the effect of potassium silicate percentages on total No. of grains per panicle, No. of unfilled grains per panicle, 1000-grain weight (g) and grain yield (ton/ha) data showed that the foliar application of potassium silicate had clearly significant effect in the two seasons of the study. It was observed that potassium silicate significantly increased the previous studied characters. Sprayed the tested cultivar by 1.5% potassium silicate caused an increase in total No. of grains/panicle as compared with other treatments, while both No. of unfilled grains/panicle and thousand grains weight were increased and reached to the maximum values under control treatment (without any potassium silicate application). As for the grain yield, data in the same Table revealed that, in 2015 season the grain yield of the tested cultivar reached to the maximum value and out-yielded when the plants sprayed by 1% potassium silicate, while in 2016 season the tested cultivar responded more to both 1% and 1.5% potassium silicate and gave the greatest grain yield (ton/ha). The superiority of potassium silicate application on No. of filled grains/panicle might be due to its high efficiency in assimilates translocation from source to sink. Furthermore, potassium silicate was sprayed at booting period that might be delayed the early aging, improved flag leaf and other active leaves, elevated current photosynthesis and prolonged active filling period by increasing leaf water potential. Also, potassium silicate led to increase the translocation of photosynthetic products (assimilates) from the source to the sink that increase the filling rate and percentage consequently increase the percentage of No. of filled grains/panicle and panicle weight resulted an increase in grain yield. Also, spraying potassium silicate might prolong active filling period reflecting in reducing unfilled grains. As previously mentioned the potassium silicate in different levels had favorable effect on grain filling by different way, which in turn apparent improvement of 1000-grain weight as improving sink-source relation which reported by Eneji *et al.* (2008) and Ghanbari *et al.* (2011). Potassium silicate as foliar spray occupied the first rank regarding its effective in elevated rice yield consequently yield is the final manifestation of all the process. Thereby, the physiological process was improved as a result of varying silicate levels foliar spray which might be decreased the consumption of photosynthates combined with increasing photosynthesis which aided transport of photosynthesis assimilates. By the way, the out-yielded of rice grain resulted from potassium silicate addition at the percentage of 1% was a function of increasing main yield components; panicles number/m^2, filled grains and heavy grains as well as high seed index. The current findings are in a similarity with those reported by Hossain *et al.* (2001). Results also revealed that potassium silicate addition helped plant growth, which might be due to the increased photosynthetic efficiency and it was exerted through the numbers of productive tillers, panicle length, the percentage of filling grains, 1000-grains weight. This corroborated the findings by (Prakash *et al.,* 2011 and Gholami and Falah, 2013). Korndörfer *et al.* (2004) and Wattanapayapkul *et al.* (2011) reported that application of potassium silicate increased grain yield by about 2-14% over the control. Effects of potassium silicate on grain yield are related to the element deposition under the leaf epidermis which results a physical mechanism of defense, reduces the lodging, increases the photosynthesis capacity and decreases the transpiration losses consequently decreased unfilled grains rate and increasing the grain yield (ton/ha).

Table 4. Total number of grains Panicle^{-1}, number of unfilled grains Panicle^{-1}, 1000-grain weight (g) and grain yield (ton/ha) of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Character	total number of grains /panicle		Number of unfilled grains/panicle		1000-grain weight (g)		Grain yield (ton/ha)	
Treatments	2015	2016	2015	2016	2015	2016	2015	2016
Potassium silicate %								
0 (without spraying)	110.19 e	119.02 e	20.88 a	21.29 a	27.94 a	27.71 a	9. 74 e	9.56 d
0.5 %	134.97 d	133.66 d	17.16 b	17.11 b	26.81 b	26.74 bc	10.21 d	10.19 c
1.0 %	145.28 b	141.98 b	9.85 d	10.42 d	27.38 a	27.19 ab	10.92 a	10.64 a
1.5 %	151.01 a	148 17 a	15.07 c	11.75 cd	26.77 b	26.69 c	10.65 b	10.48 ab
2.0 %	139.89 c	137.08 c	15.44 c	13.28 c	25.99 c	25.51 d	10.43 c	10.36 bc

Grain quality characters

Hulling, milling and head rice percentages of Giza 179 rice cultivar as affected by potassium silicate percentage during the two growing seasons 2015 and 2016 are presented in Table 5. The highest hulling, milling and head rice percentages were obtained when rice plants were treated with potassium silicate as compared with the control treatment in the both seasons, respectively. Potassium silicate at the rate of 1% gave the highest values of hulling, milling and head rice percentages, followed by, 1.5% percentage in 2015 and 2016 seasons. While, the lowest values of hulling, milling and head rice percentages were recorded when rice plants didn't receive any percentage of potassium silicate. As for, previously mentioned the potassium silicate application improved rice growth and grain filling which turn in improving hulling (%).The effect of potassium silicate fertilization on milling(%) may be due to improve growth, increase pre-heading photosynthesis rate and its products (assimilates) current photosynthesis resulted in improving grain filling which led to increase the thickness and weight of hull resulted in the increase in hulling, milling and head rice percentage. The favorable effect of potassium silicate spray on improving head rice % mainly attributed to the reduction in amylopectin % the amylose content waste increased. The current findings are in a same line with those reported by Shashidhar *et al.* (2008) and Ahmad *et al.* (2013).

Table 5. Percentage of hulling, milling and head rice of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Character	Hulling %		Milling %		Head rice %	
Treatments	2015	2016	2015	2016	2015	2016
Potassium silicate%						
0 (without spraying)	81.89 e	82.50 d	72.64 e	73.17 e	62.79 c	62.41 d
0.5 %	82.10 d	82.83 c	74.59 d	74.60 d	67.51 b	68.27 c
1.0 %	83.93 a	83.59 a	76.25 a	75.66 a	68.42 a	68.89 a
1.5 %	83.22 b	83.38 ab	75.87 b	75.29 b	68.23 a	68.69 ab
2.0 %	82.65 c	83.15 b	75.11 c	74.95 c	67.57 b	68.55 bc

Silicon content determination:

Data related to silicon content in stems, paddy grains and straw of Giza 179 rice cultivar as influenced by different percentages of potassium silicate are presented in Table 6. As for silicon content determination, data revealed that the five tested percentages of potassium silicate significantly varied in their silicon content (mg/g) in both seasons. Regarding silicon content (mg/g), the favorite values of this trait are the highest one. In both studied seasons, respectively, sprayed Giza 179 rice cultivar by potassium silicate caused an increase in silicon content in stems, paddy grains and straw as compared with control treatment. The greatest values of silicon content were observed when the tested cultivar sprayed by 2% potassium silicate. Meanwhile, the minimum values of silicon content were obtained when rice plants didn't receive any potassium silicate percentages (control treatment). This could be due to increased root activity and enhanced nutrient availability which led to the increase in nutrients uptake. The application of potassium silicate showed greater accumulation of Si content in rice plants. Higher Si content in the straw than in the paddy grains could be attributed to the less translocation of silicon from source to sink because the silicon is constituent of cell wall in the rice shoots (culms and leaves) to increase the strength of the rice internodes that minimized the lodging and also, minimize the angle between the leaves and the culms that cause an increase in erectness of the leaves which gave the chance to light to penetrate most of the rice leaves consequently increase the photosynthesis and the other biological process resulted in the improvement of plant growth and yield, so the silicon must be accumulated in the straw than in grains reported by (Jugal K. Malav and V. P. Ramani, 2016). Singh *et al.* (2002) found that silicon content in the harvested straw was more than 11% the reported critical limit for optimum growth and yield of rice was obtained as 3.7 % Si content in rice straw.

Table 6. Silicon content in stems, paddy grains and straw (mg/g) of Giza 179 rice cultivar as affected by foliar application of potassium silicate in 2015 and 2016 seasons.

Treatments / Character	silicon content in stems (mg/g)		silicon content in paddy grains (mg/g)		silicon content in straw (mg/g)	
	2015	2016	2015	2016	2015	2016
Potassium silicate %						
0 (without spraying)	0.20 e	0.17 e	0.98 e	1.06 e	3.79 e	3.71 e
0.5 %	0.27 d	0.29 d	1.49 d	1.51 d	5.77 d	5.85 d
1.0 %	0.51 c	0.50 c	1.66 c	1.69 c	6.05 c	6.15 c
1.5 %	0.66 b	0.64 b	1.80 b	1.81 b	6.32 b	6.40 b
2.0 %	0.72 a	0.75 a	1.93 a	1.97 a	6.58 a	6.70 a

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تأثير مركب سيليكات البوتاسيوم كإضافة بالرش علي النمو والمحصول وجودة الحبوب لصنف الأرز جيزة ١٧٩.

مريم طلعت ويصاغبريال

قسم بحوث الأرز – معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية – الجيزة – مصر

أجريت تجربتان حقليتان في المزرعة البحثيه بقسم بحوث الأرز، سخا، كفر الشيخ، مصر خلال موسمي الزراعة ٢٠١٥ و ٢٠١٦. وذلك بغرض دراسة تأثيراستخدام الرش الورقي بسيليكات البوتاسيوم على نمو ومحصول وجودة الحبوب لصنف الأرز جيزة ١٧٩. تم استخدام تصميم القطاعات الكاملة العشوائية في أربعة مكررات في الموسمين حيث تم استخدام الرش الورقي بسيليكات البوتاسيوم وكانت التركيزات المستخدمة من سيليكات البوتاسيوم بالأضافة الي معاملة الكنترول(بدون اضافة) هي ٠.٥% , ١% , ١.٥% و٢% سيليكات البوتاسيوم وتم الرش بنفس التركيز مرتين عند ١٥ و ٣٠ يوم من الشتل . وكانت الصفات المدروسة محتوي كلوروفيل في ورقة العلم , دليل مساحة للاوراق , وتراكم للمادة الجافة , اطوال النباتات , وعدد الفروع لل م٢ , عدد السنابل لل م٢ , طول السنبله سم, وزن السنبله جم, عدد الحبوب الكلية لكل سنبلة, وزن الالف حبة جم, محصول الحبوب طن للهكتار وايضا النسبه المئويه لتصافي التقشير والتبييض والحبوب الكامله ومحتوي السيليكون في السيقان والحبوب والقش. وقد أظهرت النتائج أن استخدام سيليكات البوتاسيوم أدى إلى زيادة معنوية في صفات النمو الخضري والمحصول ومكوناته وجودة الحبوب لصنف الارز جيزة ١٧٩. اعطي تركيز بوتاسيوم سيليكات بنسبة ١% اعلي القيم لمحتوي كلوروفيل في ورقة العلم , دليل مساحة الاوراق , وتراكم للمادة الجافة , اطوال النباتات , وعدد الفروع لل م٢ , عدد السنابل لل م٢ , طول السنبله, وزن السنبله, محصول الحبوب وايضا النسبه المئويه لتصافي التقشير والتبييض والحبوب الكامله. ولكن اعطي تركيز سيليكات البوتاسيوم بنسبة ١.٥% اعلي القيم لعدد الحبوب في السنبله وتركيز ٢% اعلي القيم لمحتوي السيليكون في السيقان والحبوب والقش. وتتراوح الأختلافات في النتائج بين تركيزات الرش الورقي بسيليكات البوتاسيوم المختلفه. ووفقا للنتائج السابقة يمكن الاستنتاج أن الرش بإستخدام سيليكات البوتاسيوم مرتين بنفس التركيز ١.٠٪ وذلك عند ١٥ و ٣٠ يوم من الشتل كانت أفضل معامله لتحسين النمو الخضري وايضا للحصول على أعلي محصول حبوب بالإضافة إلى صفات جودة الحبوب لصنف الأرز جيزة ١٧٩و لذلك توصي الدراسة برش نباتات الارز (جيزة ١٧٩) بسليكات البوتاسيوم مرتين عند ١٥ و ٣٠ يوم من الشتل بتركيز ٢% وذلك للحصول علي اعلي محصول حبوب وصفات الجودة للحبوب.