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# Impact the foliar application by Potassium Silicate on rice seed productivity of cultivated varieties (*Oryza Sativa* L.)

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FARM exploration was completed at Agriculture Research station in Kafr-Elsheikh governorate, Egypt, through 2022 and 2023. The main objective of investigation, enhancement the productivity of some rice cultivars in poor soil affected with drainage water by the foliar application potassium silicate at three rates, i.e., 2, 4 and 6g/L. Foliar use of Si at various rates altogether expanded every one of yield parts and yield t/ha as contrasted and untreated plants as control treatment during the two seasons. Between nine different traits were measured including morphological and yield components. Among concentrates of silicate potassium, apply silicate potassium at rate 6 g/ L recorded significantly higher grain yield and its component when compared control treatment during two seasons. Regarding to rice varieties, E. hybrid No.1 Sakha104 and Giza 178 recorded the desirable values for agronomic characteristics. The optimum combination which recorded the highest rice grain yield when E. hybrid No.1 and Giza 178 rice varieties foliated with magnesium silicate at 6g/L during growing seasons. So, could be suggested that, to get highest seed yield with drainage water should be cultivated Egyptian Hybrid1 or Giza 178 and Sakha 104 varieties under this investigation.

**Keywords**: Rice, potassium silicate, growth, yield, seed quality, drainage water

## 1. Introduction

Rice is an importance food crop for Egypt and a large portion of African nations, as well as, comprises a significant piece of the eating regimen for some others (Hafez et al. 2024). Since quite a while back, the interest in rice has expanded quickly. In Egypt, the rice developed region is around 0.483 million hectares with average 8.9 t/ha and the yearly creation of this area more is than 4.3 million tons of paddy rice (EAS 2023). The rice creation needs to increment to 40% for all rice environments much under different pressure regions to accomplish the food security by 2025 (Pennisi 2008).

One of the fundamental biotic burdens which compromise rice creation at different stages from seed to seed is saltiness (Abou Hussen et al. 2020; Farid *et al.*, 2021). In the approaching years, under severe climate change conditions, one would anticipate to supply the demands of an overpopulating population, increase the demand for nutrition, and yield rice of a much higher quality by utilizing silicon solubilizes Rakesh & Shankhdhar (2017). Si supplementation considerably reduced a variety of symptoms associated with biotic and abiotic stress. To increase plant performance and productivity, silicate-containing fertilizers must be used in agricultural crop production systems.

It is reported that, maximum grain diameter and protein were produced by silicon (0.50% silicon solution), while maximum numbers of productive tillers, straw yield, spikes per panicle, 1000 grain weight, paddy yield, and grain starch were produced by silicon (1.00% silicon solution) (Ahmad et al. 2013; Jitendera et al. 2019). The recommended segment, in rice fields, advantage of Si composts (for the most part open in the sorts of calcium met silicate, potassium silicate, sodium silicate, and sugarcane bagasse) was reached to 1-2 t ha$^{-1}$ (Liu et al. 2009) which provides a critical creation cost for lamentable farmers. First one seed increases the rice productivity by around half. Where, the productivity parts its phenomenal seed and applies the social practices. Therefore, the key goal of this assessment is to focus on the impact of various levels of potassium silicate on seed yield of some rice cultivars.

## 2. Materials and Methods

The present study was carried out at Experimental Farm at Agricultural Research Station, Kafr El-Sheikh governorate, Egypt through two successive rice seasons; 2022 and 2023. The experiments were carried out in split-plot design and the factors were distributed according in Randomized Complete Blocks Design (RCBD) arrangement, where apply silicates potassium concentrates levels (mineral origin), i.e. control (without silica),

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2g/L (240g/ fed), 4g/L (480 g/fed) and 6g/L (720 g/fed) while, six rice cultivars (E. hybrid No1, Giza 178,Sakha104, Sakha108, Giza 177 and Sakha 107) were allocated in the sub-plot. Four replications and a randomised complete block design (RCBD) were combined with the split plot design. The rice cultivars were allocated to sub-plots, and the potassium silicate levels were allotted to the main plots. The subplot measured 4 by 4 meters (16 $m^2$). The preceding winter crop was wheat the expiring the two seasons for the review. Soil tests were taken from the trial site at the profundity of 0-30 cm from the dirt surface, air-dried, then, at that point, ground to go through a two mm sifter and very much blended soil tests were genuinely and synthetically dissected by Black, et al (1965) and Dark et al. (1965 sediments were laid (Table 1 and Table 2).

**Table 1. Physical and chemical analyses of the experimental soil sites in 2022 and 2023 seasons.**

| Analysis | 2022 | 2023 |
|---|---|---|
| **Mechanical analysis (%)** | | |
| **Clay** | **59.70** | **58.83** |
| **Silt** | **29.10** | **30.30** |
| **Sand** | **10.57** | **10.87** |
| **Texture class** | **Clay** | **Clay** |
| **Chemical analysis** | | |
| **Organic matter%** | **1.55** | **1.50** |
| **E.C. dS/m** | **2.00** | **2.03** |
| **PH** | **8.10** | **8.14** |
| **N (Tot. ppm)** | **450** | **475** |
| **P (Ava. ppm)** | **14.3** | **16.5** |
| **K (Ava. ppm)** | **325** | **326** |
| **Zn (Ava. ppm)** | **0.87** | **0.89** |

**Table 2. Physical and chemical analyses of the drainage Irrigation Water of NO.8 drain (D8) in 2022 and 2023 seasons.**

| Chemical | 2022 | 2023 |
|---|---|---|
| **pH** | **7.51** | **7.58** |
| **EC (dS $m^{-1}$)** | **2.54** | **2.58** |
| **ANIONS (meg/L)** | | |
| **$C_3^-$** | **---** | **---** |
| **$HCO_3^-$** | **4.89** | **4.93** |
| **CL** | **14.50** | **14.90** |
| **$SO_4^-$** | **6.01** | **6.41** |
| **CATIONS (meg/L)** | | |
| **Ca** | **5.59** | **5.63** |
| **Mg** | **3.86** | **3.89** |
| **Na** | **15.33** | **15.81** |
| **K** | **0.62** | **0.64** |
| **Heavy Metals (ppm)** | | |
| **Cd** | **0.150** | **0.155** |
| **Pb** | **4.20** | **4.28** |

Following the recommended fertilisation of the permanent field and nursery area, 120 kg of rice seeds per hectare were planted and incubated for 48 hours after being submerged in water for 24 hours. Rice seeds were easily dispersed at a depth of 2-3 cm in nursery water on May 1st of each season, and other cultural techniques were implemented by the guidelines. At harvesting time, ten random plants from each sub-plots were selected and panicles number of the central square meter from each sub-plot was counted, then, ten main panicles from each sub-plot were randomly taken for decide their absolute number of grains, filled grains rate and 1000-grain weight (g). An area of 6 square meters in the focal point of each sub-plot was helpfully collected, air dried and sifted to assess grain and straw yields, and then changed into t/ha. Also, collect file was determined as proportion between grain yield and natural yield (grain yield and straw yield).as suggested by SES (IRRI 2016).

All collected data were statically analysed, according to Gomez and Gomez, (1984), using Costat Computer program. Treatment means comparing using LSD test.

## 2 .Results

The two seasons' control treatment Furthermore, in comparison to other rice cultivars, the upsides of these characteristics progressively rose with different cultivars, particularly for the Egyptian hybrid, which was followed by Giza 178 and Sakha 104. This suggests that the tested cultivars exhibited genetic diversity. It is possible to propose that Si enhances crop development rate and subsequently tillering capacity according to Coskun et al. (2016). Additionally, the upsides of such characters were expanded slowly by expanding the degrees of Si up to 6 g/l. In comparison among the other levels, it can be noticed that the highest values for no of panicle/plant, panicle length and weight were acquired by foliar utilization of 6 g/l of potassium silicate in the first and second seasons, separately.

**Table 3. The mean effect for potassium silicate on no of panicles/plant, panicle length and weight of some rice cultivars during 2022 and 2023 seasons.**

| | **2022** | | | **2023** | | |
|---|---|---|---|---|---|---|
| **Main effects** | **No. of Panicles /plant** | **Panicle length (cm)** | **Panicle weight (g)** | **No. of Panicles /plant** | **Panicle length (cm)** | **Panicle weight (g)** |
| Concentrate(c) | | | | | | |
| Control | 18.53d | 16.20c | 3.37b | 17.23d | 15.60c | 2.91d |
| 2 g/l | 21.50c | 17.46b | 3.74ab | 20.20c | 16.89b | 3.08c |
| 4 g/l | 23.53b | 17.93b | 3.83a | 22.23b | 17.33b | 3.28b |
| 6 g/l | 25.7a | 18.70a | 4.01a | 24.64a | 18.10 a | 3.50a |
| F- test | ** | ** | ** | ** | ** | ** |
| Varieties(v) | | | | | | |
| E hybrid 1 | 27.40 a | 21.27a | 4.49a | 26.208a | 20.67a | 3.93a |
| Giza 178 | 23.15b | 17.75b | 4.01c | 21.85b | 17.15b | 3.48b |
| Sakha 104 | 22.2bc | 17.25bc | 3.61d | 20.90bc | 16.70bc | 3.09c |
| Sakha 108 | 21.45cd | 17.05c | 4.07b | 20.15cd | 16.45c | 3.49b |
| Giza 177 | 20.65d | 16.65c | 3.37e | 19.35d | 16.05c | 2.88d |
| Sakha 107 | 19.3e | 15.47d | 2.88f | 18.00e | 14.89d | 2.25e |
| F- test | ** | ** | ** | ** | ** | ** |
| interaction | | | | | | |
| C*v | ** | * | ns | ** | ** | ns |

*Significant at 5 % level, ** highly Significant at 1 % level, NS Not Significant.

Data presented in Table 4 and Fig (1), the highest levels of potassium silicate with Egyptian hybrid 1, Giza 178 and Sakha 104 recorded the highest no. of panicles/plant, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons. That, may be referred to the genetic background for indica/Japonica rice cultivars more tolerant to poor quality water than the Japonica cultivars. Data presented in Table 5 and Fig (2) the highest levels of potassium silicate with Egyptian hybrid 1 recorded the highest value for panicle length, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons.

**Table 4. No. of Panicle /plant as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | **2022** | | | | **2023** | | | |
|---|---|---|---|---|---|---|---|---|
| Concentrate | 0 | 2g/l | 4g/l | 6g/l | 0 | 2g/l | 4g/l | 6g/l |
| E hybrid 1 | 24.0 d-g | 26.8bc | 29.6 a | 28.2ab | 22.7d-g | 25.5bc | 28.3a | 28.33a |
| Giza 178 | 19.4ij | 22.4 fgh | 22.6e-h | 28.2ab | 18.1ij | 21.1fgh | 21.3e-h | 26.9ab |
| Sakha 104 | 18.6j | 22.2gh | 22.8efg | 25.2cd | 17.3j | 20.9gh | 21.5efg | 23.9cd |
| Sakha 108 | 18.2 jk | 20.8hi | 22.8efg | 24. 0d-g | 16.9jk | 19.5hi | 21.5efg | 22.7d-g |
| Giza 177 | 16.6 k | 18.00 jk | 23.6d-g | 24.4de | 15.3k | 16.7jk | 22.3d-g | 23.1de |
| Sakha 107 | 14.4l | 18.8 j | 19.8 ij | 24.4de | 13.1l | 17.5j | 18.5ij | 22.9def |

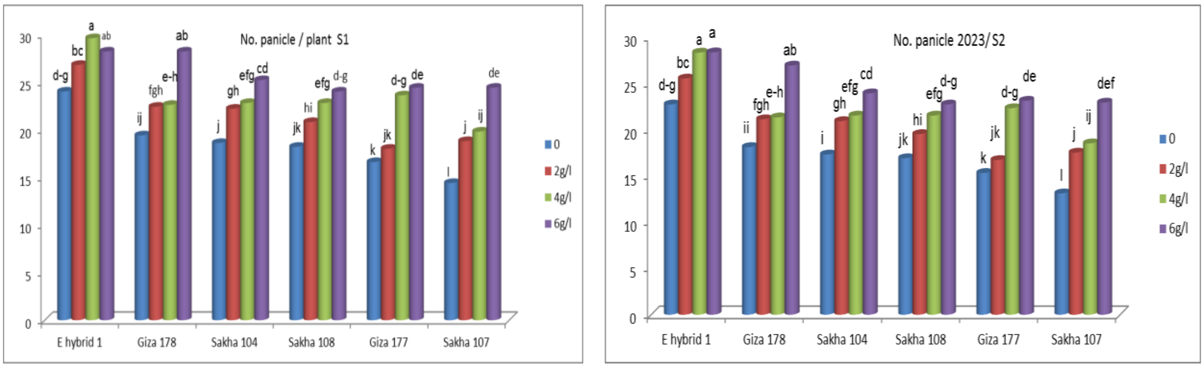

**Fig. 1. The interaction between levels silicate potassium and rice varieties selection, on number of panicles / plant during the 2022 and 2023 rice growing.**

**Table 5. Panicle length as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| Concentrate | 0 | 2g/l | 4g/l | 6g/l | 0 | 2g/l | 4g/l | 6g/l |
| E hybrid 1 | 20.ob | 21.66a | 21.6a | 21.8a | 19.4b | 21.07a | 21a | 21.2a |
| Giza 178 | 16.4fgh | 17.2d-g | 18.6c | 18.8bc | 15.8ghi | 16.6e-h | 18.0cd | 18.2bc |
| Sakha 104 | 17.0efg | 17.2d-g | 16.4fgh | 18.4cd | 16.4fgh | 16.8d-g | 15.8ghi | 17.8cde |
| Sakha 108 | 16.0gh | 16.6fgh | 17.6c-f | 18cde | 15.4hi | 16.0ghi | 17c-g | 17.4c-f |
| Giza 177 | 14.4ij | 16.6fgh | 16.8e-h | 18.8bc | 13.8jk | 16.0ghi | 16.2f-i | 18.2bc |
| Sakha 107 | 13.4j | 15.5hi | 16.6fgh | 16.4fgh | 12.8k | 14.9ij | 16.0ghi | 15.8ghi |

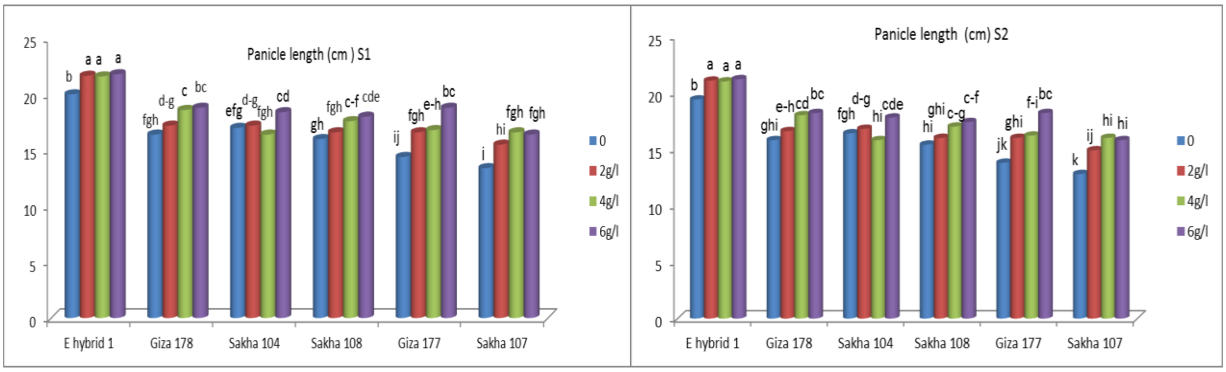

**Fig. 2. The interaction between levels silicate potassium and rice varieties selection, panicle length (cm) during the 2022 and 2023 rice growing.**

Data presented in Table (6) the highest levels of potassium silicate with Egyptian hybrid 1 recorded the highest value panicle weight, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons. Indicated that potassium silicate plays an important role in tolerant to drainage water then increase the crop growth rate and panicle weight.

**Table 6. Panicle weight as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| Concentrate | 0 | 2 g/l | 4 g/l | 6g /l | 0 | 2 g/l | 4 g/l | 6 g/l |
| E hybrid 1 | 4.24 | 4.47 | 4.56 | 4.72 | 3.54 | 3.77 | 3.86 | 4.02 |
| Giza 178 | 3.78 | 3.98 | 4.07 | 4.21 | 3.08 | 3.28 | 3.37 | 3.51 |
| Sakha 104 | 3.4 | 3.58 | 3.66 | 3.78 | 2.7 | 2.88 | 2.96 | 3.08 |
| Sakha 108 | 3.84 | 4.05 | 4.13 | 4.27 | 3.14 | 3.35 | 3.43 | 3.57 |
| Giza 177 | 3.18 | 3.35 | 3.42 | 3.54 | 2.48 | 2.65 | 2.72 | 2.84 |
| Sakha 107 | 2.72 | 2.87 | 2.93 | 3.03 | 2.02 | 2.17 | 2.23 | 2.33 |

NS Not SignificantThe information demonstrated that foliar use of different silicon levels caused an expansion in the yield parts as contrasted and the control treatment during the two seasons as displayed in Table (7). Furthermore, the positive aspects of these characters increased gradually as the degrees of Si increased to 6 g/l. Upon examining various levels, it is highly probable that the highest values for the number of filled grains/panicle, 1000-grain weight, and richness rate were achieved through foliar application of 6 g/l of potassium silicate in the first and second seasons, respectively. The improving of no of 100- grain weight herein of Sakha 108 , Sakha 104 and Giza 177 by foliar use of Si at various level might be because of the gainful job of silicon in improving rice salt resilience as well as the magnesium component which addresses the focal molecule of chlorophyll compounds, in rice plants on the other hand, the Egyptian hybrid 1 , Giza 178 and Sakha 104 recorded the desirable values for no. of filled grains / panicle and fertility percentage with high levels of potassium silicate compared to other treatments.

**Table 7. The mean effect of potassium silicate on no of filled grains/panicle, 1000-grain weight and fertility % of some rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | 2023 | | |
|---|---|---|---|---|---|---|
| **Main effect** | **No. of filled grains /panicle** | **1000 grain weight (gm)** | **Fertility percentage %** | **No. of filled grains /panicle** | **1000 grain weight (gm)** | **Fertility percentage %** |
| Concentrate (c) | | | | | | |
| Control | 62.13d | 24.12c | 83.05c | 60.80d | 23.60d | 84.06c |
| 2 g/l | 81.33c | 26.06b | 86.11b | 80.03c | 25.59c | 86.19b |
| 4 g/l | 88.93b | 26.95a | 88.39a | 87.63b | 26.72b | 88.31a |
| 6 g/l | 93.53a | 27.73a | 88.39a | 92.23a | 27.57a | 86.19b |
| F-test | ** | ** | ** | ** | ** | ** |
| Varieties(v) | | | | | | |
| E hybrid 1 | 105.75a | 23.83d | 87.23bc | 104.45a | 23.35d | 87.16b |
| Giza 178 | 98.75b | 23.51d | 88.26b | 97.45b | 22.95d | 88.20b |
| Sakha 104 | 89.45c | 28.91a | 90.24a | 88.15c | 28.60a | 90.20a |
| Sakha 108 | 72.05d | 27.79b | 86.62c | 70.75d | 27.55b | 83.31d |
| Giza 177 | 65.7e | 26.71c | 82.86d | 64.4e | 26.55c | 82.67d |
| Sakha 107 | 57.2f | 26.54c | 83.70 d | 55.90f | 26.22c | 85.34c |
| F-test | ** | ** | ** | ** | ** | ** |
| interaction | | | | | | |
| C*v | ** | ** | ** | ** | ** | ** |

*Significant at 5 % level, ** highly Significant at 1 % level, NS Not SignificantThe interaction between the different levels of potassium silicate and rice cultivars for no of filled grains/panicle is present in Table 8 and Fig (3). Data demonstrated that, the highest levels of potassium silicate with Egyptian hybrid1, recorded the highest no of filled grains / panicle, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons.

**Table 8. Number of filled grains /panicle as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| **Concentrate** | **0** | **2 g/l** | **4 g/l** | **6 g/l** | **0** | **2 g/l** | **4 g/l** | **6 g/l** |
| **E hybrid 1** | **92.2f** | **100.0de** | **114.0b** | **116.8a** | **90.9f** | **98.7de** | **112.7b** | **115.5a** |
| **Giza 178** | **88.0g** | **99.0e** | **104.0c** | **104.0c** | **86.7g** | **97.7e** | **102.7c** | **102.7c** |
| **Sakha 104** | **60.2o** | **93.0f** | **101.0d** | **103.2c** | **59.3o** | **91.7f** | **99.7d** | **101.9c** |
| **Sakha 108** | **58.2p** | **68.l** | **78.0i** | **84.0h** | **56.9p** | **66.7l** | **76.7i** | **82.7h** |
| **Giza 177** | **48.0q** | **65.0m** | **71.6k** | **78.2i** | **46.7q** | **63.7m** | **70.3k** | **76.9i** |
| **Sakha 107** | **45.0r** | **63.0n** | **65.0m** | **75.0j** | **44.5r** | **61.7n** | **63.7m** | **73.7j** |

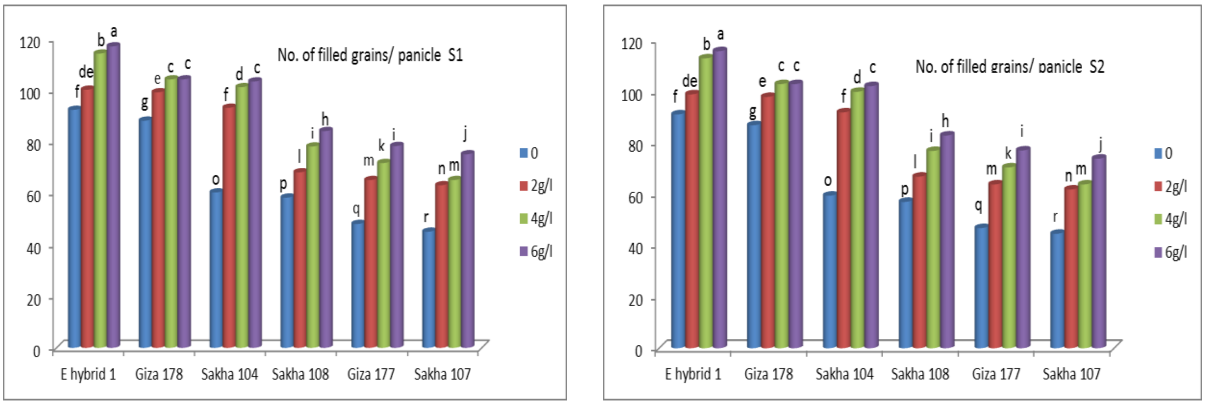

**Fig. 3. The interaction between levels silicate potassium and rice varieties selection, on number of filled grains / panicle during the 2022 and 2023 rice growing.**

The interaction between the different levels of potassium silicate and rice cultivars no 1000-grain weight (g) is present in Table 9 and Fig (4). Data demonstrated that, the highest levels of potassium silicate with Egyptian hybrid recorded the highest value of 1000-grain weight, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons. Indicate that japonica rice cultivars were heavy in 1000-grains weight compared to indica/japonica cultivars.

**Table 9. 1000 grain weight as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| **Concentrate** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| E hybrid 1 | 25.4ghi | 28cde | 30.8b | 33.00a | 24.7ghi | 27.3cde | 30.1b | 32.3a |
| Giza 178 | 26.6efg | 28.4cd | 28.8c | 29.2c | 25.9efg | 27.7cd | 28.1c | 28.5c |
| Sakha 104 | 25.8fgh | 27.2def | 28.2cd | 28.8c | 25.1fgh | 26.5def | 27.5cd | 28.1c |
| Sakha 108 | 23.2kl | 27.8cde | 28cde | 28.6cd | 22.5kl | 27.1cde | 27.3cde | 27.9cd |
| Giza 177 | 24.00i-l | 24.4h-k | 24i-l | 25.2ghi | 20.3m | 23.7h-k | 23.3i-l | 24.5ghi |
| Sakha 107 | 22.8l | 23.6jkl | 25hij | 24.8hij | 22.1l | 22.9jkl | 24.3hij | 24.1hij |

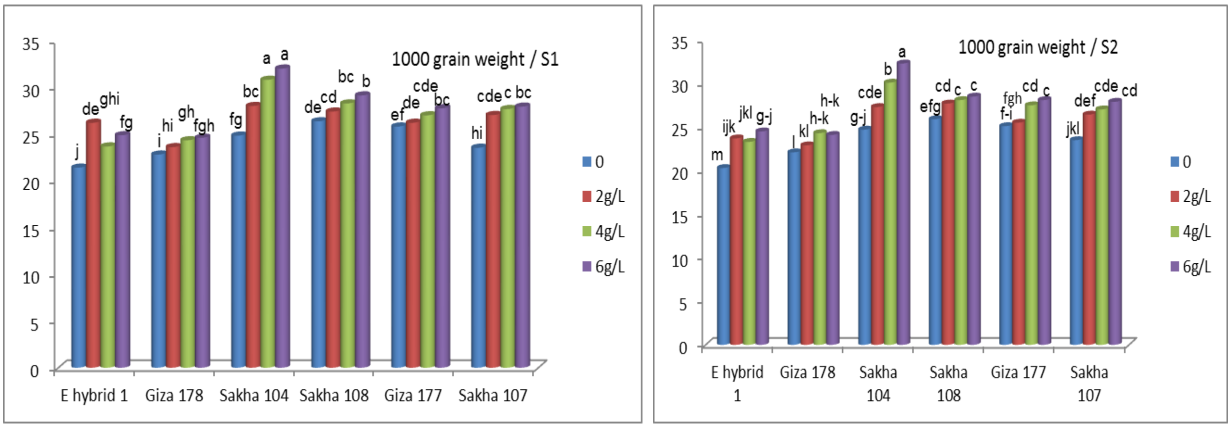

**Fig. 4. The interaction between levels silicate potassium and rice varieties selection, on number of panicles / plant during the 2022 and 2023 rice growing**

The interaction between the different levels of potassium silicate and rice cultivars fertility %is present in Table 10 and Fig 5. Data demonstrated that, the highest levels of potassium silicate with Egyptian hybrid 1, recorded the highest value of seed set %, while the lowest value was observed when Giza 177 growing under control treatment during two seasons.

**Table 10. Fertility % as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| 2022 | | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| Concentrate | 0 | 2 g/L | 4 g/L | 6 g/L | 0 | 2 g/L | 4 g/L | 6 g/L |
| E hybrid 1 | 84.43 g | 78.62h | 91.96 bc | 93.89a | 84.32g | 78.47h | 91.94ab | 93.91a |
| Giza 178 | 86.96ef | 90.83 bc | 88.13de | 87.10e | 86.87ef | 90.81bc | 88.08de | 87.04e |
| Sakha 104 | 87.84 de | 90.46bc | 91.49bc | 91.17bc | 87.73de | 90.43bc | 91.47bc | 91.15bc |
| Sakha 108 | 87.14e | 87.86de | 84.60g | 86.87ef | 87.02e | 87.76de | 84.47g | 73.98 |
| Giza 177 | 72.97h | 84.87fg | 89.51cd | 84.11g | 72.54i | 84.72fg | 89.45cd | 83.97g |
| Sakha 107 | 78.94 h | 84.02g | 84.64g | 87.21 e | 85.90efg | 84.48g | 84.48g | 87.11e |

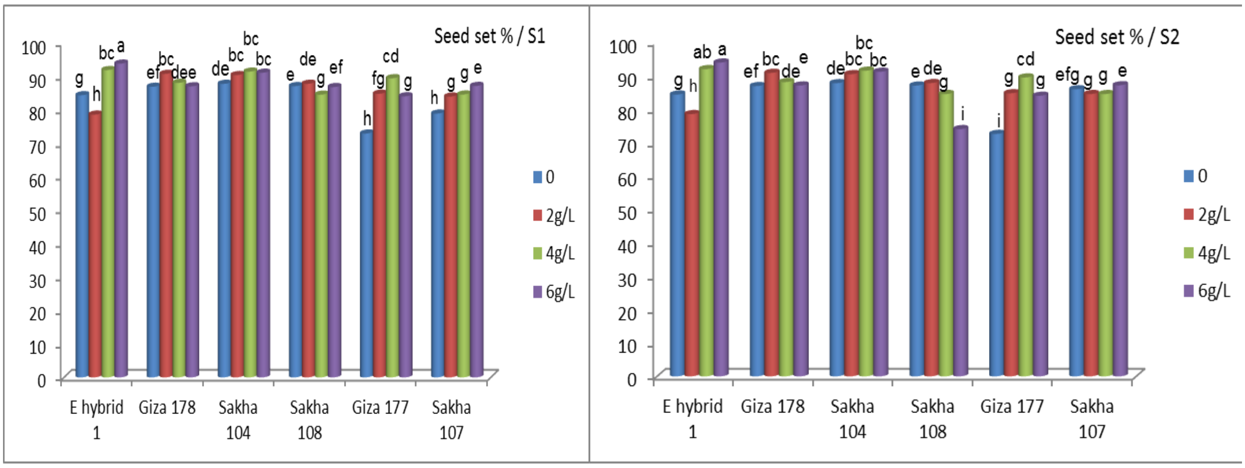

**Fig. 5. The interaction between levels silicate potassium and rice varieties selection, on fertility % during the 2022 and 2023 rice growing.**

That's what the information showed foliar utilization of different silicon levels caused an expansion in the yield characters as contrasted and the control treatment (T1) during the two seasons. Also, the upsides of no. of total grains /panicle, grain yield and harvest index were expanded steadily with expanding the levels of Si up to 6 g/l, in comparison among the other levels, it very well may be seen that, the most elevated values were acquired by foliar utilization of 6 g/L of potassium silicate during the first and second seasons, individually. From these outcomes, it very well may be seen that silicon medicines had stamped positive and huge expanding impact on the concentrated on characters as displayed in Table 11.

**Table 11.The mean effect of potassium silicate on no of total grains/panicles, grain yield and harvest index of some rice cultivars during 2022 and 2023 seasons.**

| | 2022 | | | 2023 | | |
|---|---|---|---|---|---|---|
| **Main effect** | **No. of total grains/ panicle** | **Grain yield t/fed** | **Harvest index** | **No. of total grains/ panicle** | **Grain yield t/fed** | **Harvest index** |
| Concentrate(c) | | | | | | |
| Control | 74.20d | 2.18d | 38.55d | 72.80d | 2.60d | 37.25d |
| 2 g/l | 94.66c | 2.78c | 43.93c | 93.26bc | 3.10c | 41.78c |
| 4 g/l | 100.23ab | 3.75b | 51.18ab | 98.83b | 3.81b | 49.88ab |
| 6 g/l | 105.45a | 4.07a | 53.8a | 106.8a | 4.16a | 52.46a |
| F-test | ** | ** | ** | ** | ** | ** |
| Varieties(v) | | | | | | |
| E hybrid 1 | 121.20a | 4.32a | 56.20a | 119.8a | 4.19a | 54.90a |
| Giza 178 | 111.90b | 3.96b | 53.15ab | 110.5b | 3.83b | 51.85ab |
| Sakha 104 | 98.85c | 3.42c | 51.525b | 97.45c | 3.30d | 50.22b |
| Sakha 108 | 83.275d | 2.94d | 50.35b | 86.00d | 3.44c | 47.72b |
| Giza 177 | 78.85e | 2.38e | 39.15c | 77.45e | 2.83e | 37.85c |
| Sakha 107 | 67.75f | 2.14f | 30.825d | 66.35f | 2.91f | 29.52d |
| F-test | ** | ** | ** | ** | ** | ** |
| interaction | | | | | | |
| C*v | ** | ** | ** | ** | ** | ** |

*Significant at 5 % level, ** highly Significant at 1 % level, NS Not Significant

The improving of grain yield got thus by foliar utilization of Si at various levels, might be because of the useful job of silicon in upgrading rice salt resistance , the reaction of rice cultivars for potassium silicate application under poor flooded water different is given their hereditary background where the Egyptian mixture 1 , Giza 178 and Sakha 104 recorded the most noteworthy qualities for complete grains/panicle, grain yield and collect file. Khan *et al.* (2019) viewed that as exogenous use of Si under saltiness stress fundamentally further developed photosynthesis rates. The interaction between the different levels of potassium silicate and rice cultivars for no of total grains/panicle is present in Table 12 and Fig 6. Data demonstrated that, the 2 g/L level of potassium silicate with Egyptian hybrid 1, recorded the highest no of total grains /panicle, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons.

**Table 12. No. of total grains panicle as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | **2022** | | | | **2023** | | | |
|---|---|---|---|---|---|---|---|---|
| Concentrate | 0 | 2 g/L | 4 g/L | 6 g/L | 0 | 2 g/L | 4 g/L | 6 g/L |
| E hybrid 1 | 109.2e | 127.2a | 124.0b | 124.4b | 107.8e | 125.8a | 122.6b | 123.0b |
| Giza 178 | 101.2g | 109.0e | 118.0c | 119.4c | 99.8f | 107.6e | 116.6c | 118.0c |
| Sakha 104 | 69.0n | 102.8f | 110.4e | 113.2d | 67.6l | 101.4f | 109.0e | 111.8d |
| Sakha 108 | 66.8o | 77.4l | 92.2i | 96.7h | 65.4m | 76.0j | 90.8g | 111.8d |
| Giza 177 | 65.8o | 76.6l | 80.0k | 93.0i | 64.4m | 75.2jk | 78.6i | 91.6g |
| Sakha 107 | 57.0p | 75.0m | 76.8l | 86.0j | 51.8n | 73.6k | 75.4j | 84.6h |

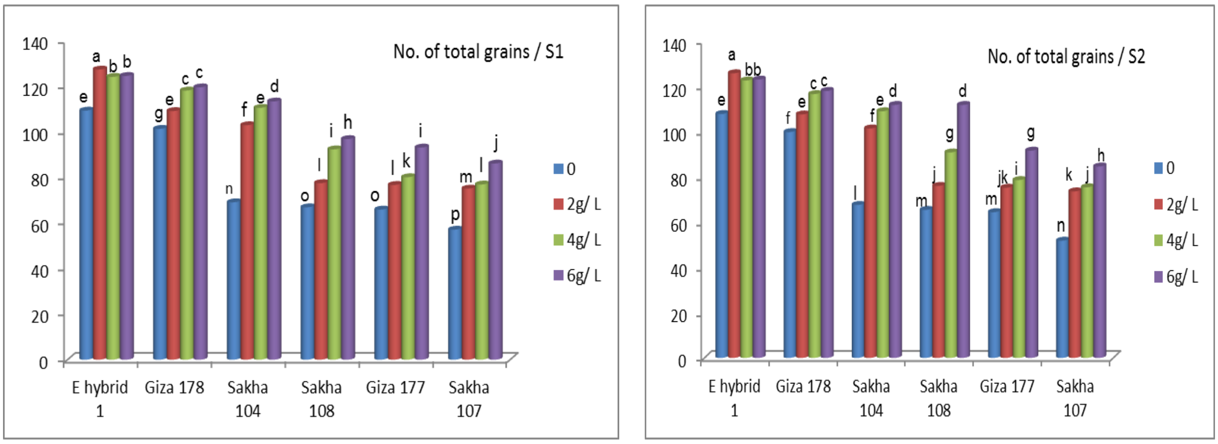

**Fig. 6. The interaction between levels silicate potassium and rice varieties selection, on number of total grains / panicle during the 2022 and 2023 rice growing**

The interaction between the different levels of potassium silicate and rice cultivars for grain yield t/fed is present in Table 13 and Fig 7. Data demonstrated that, the highest levels of potassium silicate with Egyptian hybrid 1, Sakha 104 recorded the highest values for grain yield t/ fed., while the lowest value was observed when Sakha 107 growing under control treatment during two seasons.

**Table 13. Grain yield/fed as affected by the interaction between Silica levels and rice cultivars during 2022 and 2023 seasons.**

| | **2022** | | | | **2023** | | | |
|---|---|---|---|---|---|---|---|---|
| **Concentrate** | **0** | **2 g/L** | **4 g/L** | **6 g/L** | **0** | **2 g/L** | **4 g/L** | **6 g/L** |
| E hybrid 1 | 3.61e | 3.90d | 4.88b | 4.88b | 3.48fg | 3.78de | 4.75b | 4.75b |
| Giza 178 | 2.81hi | 3.44f | 4.71c | 4.71b | 2.69n | 3.31h | 4.59c | 4.75b |
| Sakha 104 | 1.82m | 3.09g | 3.70e | 5.08a | 1.70p | 2.97kl | 3.58f | 4.95a |
| Sakha 108 | 1.92m | 2.43k | 3.37f | 4.03d | 2.85lm | 3.26hi | 3.24hi | 3.90d |
| Giza 177 | 1.79m | 1.95n | 3.29f | 2.86h | 2.41o | 2.49o | 3.17ij | 3.24hi |
| Sakha 107 | 1.11o | 2.21l | 2.55jk | 2.64ij | 2.46o | 2.78mn | 3.04jk | 3.38gh |

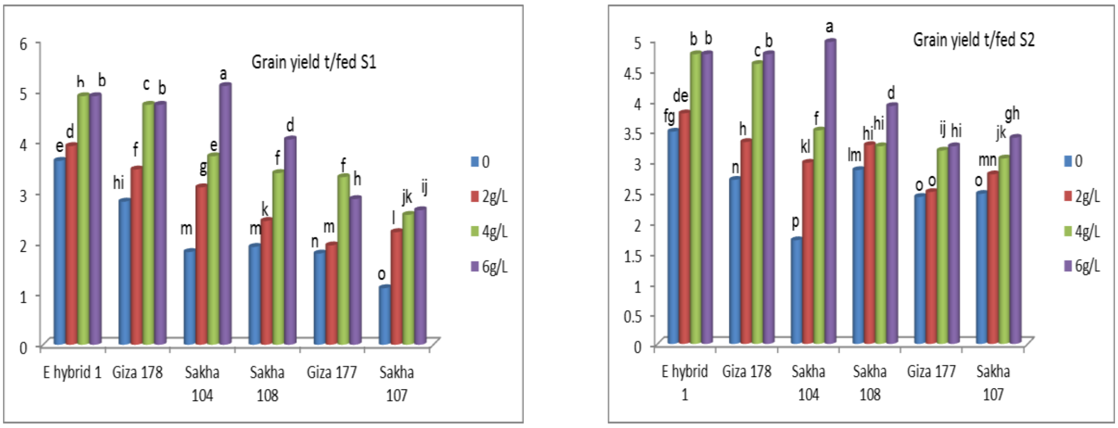

**Fig. 7. The interaction between levels silicate potassium and rice varieties selection, on grain yield t/fed during the 2022 and 2023 rice growing.**

The interaction between the different levels of potassium silicate and rice cultivars for harvest index % is presented in Table 14 Fig 8. Data demonstrated that, the highest levels of potassium silicate with Egyptian hybrid 1 and Giza 178 followed by Sakha 104 and Sakha 108 recorded the highest value of harvest index%, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons. Micronutrients, for example, silicon are the most significant for economical creation of concentrated on rice cultivars. That's the comparable investigation discovered, that adjusting the micronutrients for rice development improved the quality and yield Ma et al. (2008). These results were agreement with Hammoud et al (2020). In 2018, the release of Sakha108, a high-yielding cultivar modified to increase rice output in Egypt**.**

**Table 14. Harvest index % as affected by the interaction between Silica levels and rice cultivars during 2022and 2023 seasons.**

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| **Concentrate** | **0** | **2 g/L** | **4 g/L** | **6 g/L** | **0** | **2 g/L** | **4 g/L** | **6 g/L** |
| E hybrid 1 | 52.0f | 53.7e | 57.6 | 61.5a | 53.2klm | 50.8lm | 64.60abc | 53.9jkl |
| Giza 178 | 47.4g | 48.5g | 58.4b | 58.3bc | 47.3n | 50.8lm | 62.6cde | 57.1ghi |
| Sakha 104 | 44.1h | 47.7g | 56.0d | 58.3bc | 37.0o | 51.1lm | 56.6g-j | 67.26a |
| Sakha 108 | 37.3i | 53.7e | 53.7e | 56.7bcd | 62.2c-f | 60.7def | 50.6m | 63.3bcd |
| Giza 177 | 25.4l | 30.5k | 47.4g | 53.3ef | 59.2fgh | 56.4g-k | 59.2fgh | 56.0h-k |
| Sakha 107 | 25.1l | 29.5k | 34.0j | 34.7 | 65.21abc | 65.96ab | 62.4c-f | 57.4ghi |

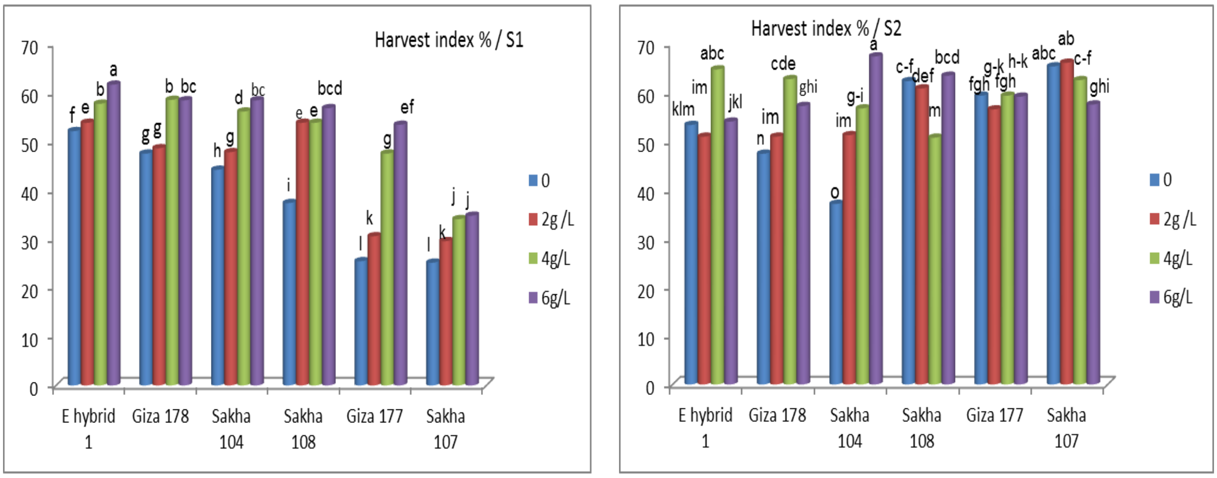

**Fig. 8. The interaction between levels silicate potassium and rice varieties selection, on harvest index% during the 2022 and 2023 rice growing.**

## Discussion

Crop output was limited by irrigation from drainage water, which is regarded as a significant environmental factor Tester and Munns (2008) and Elgamal et al. (2023). The current study's findings showed that the parameters under investigation were negatively impacted by drainage water. Despite the fact that silicon (Si) is thought of as a non-essential element Taize (2006), the majority of plant species can thrive when Si is applied externally. In addition to normal growth settings, this boost in plant growth caused by Si treatment also occurs under stressful conditions. Ma and associates (2007).

Under stressful circumstances, silicon influences several processes in plants, one of which is an improvement in the water status of the plants. Romero-Aranda et al. (2006) noted that while high concentrations of Si may have hindered the ability of these transporters to uptake in rice, strong affinity of P for metals, such as Mn and Fe, may diminish its plant content and alleviate metal toxicity. Grain content overall can represent the decrease in soil as a result of the P rate, but straw cannot.

From these outcomes, the improvement of no of panicles/plant got in this by foliar utilization of Si at various level might be because of the advantageous job of silicon in upgrading rice salt resilience, as well as, the magnesium component which addresses the focal iota of chlorophyll compounds. In this regard, moreover, exogenous utilization of Si under saltiness stress fundamentally further developed photosynthesis rates. Additionally, the advantageous job in keeping balance content of K component in monitor cell of plant.

In this regard, different agents tracked down that, the utilization of Si at various sources to rice plants caused an improvement in their plant level and number of panicles/m$^2$ (Ahmed *et al.* 2013). Silicon is a significant micronutrient for solid and serious development of the examined (Brunings *et al.* 2009). Job of silicon in plant development has been examined in silicon gathering and it appeared essentially affecting (Jinab *et al.* 2008).

The decrease of silicon-prompted pressure as referenced in past examinations is credited to underlying as well as biochemical impacts, for example, upgrading photosynthetic boundaries (Ma 2004). The interaction between the different levels of potassium silicate and rice cultivars for harvest index % that, the highest levels of potassium silicate with Egyptian hybrid 1 and Giza 178 recorded the highest value of harvest index%, while the lowest value was observed when Sakha 107 growing under control treatment during two seasons. Micronutrients, for example, silicon are the most significant for economical creation of concentrated on rice cultivars. That's the comparable investigation discovered, that adjusting the micronutrients for rice development improved the seed yield (Ma *et al.* 2008; Mandal and Ghosh 2021; Abo-Youssef and Bahgat 2023).

While P application increased soil P level, no effect on rice agronomics was detected. This discovery may help to explain the observed reduction in soil Al when both soil Si and P were increased following the addition of P fertiliser and soil Si sources. Conversely, rice's agronomics and Si uptake were affected by Si treatments. When foliarly applied Si and wollastonite treatments were compared, the substantial impact of Si sources on yield attributes was found to be more noticeable than when Si sources were compared to the check. On the other hand, Prakash et al. (2011) found that foliar application of silicic acid at 2 and 4 mL L1 improved tillering ability compared to the control in a wetland rice field trial. However, Crusciol, et al. (2013) found a correlation between stress conditions and the higher yield observed in these studies. Under comparable stress conditions, silicon-enhanced synthesis was linked to the buildup of proline and total sugars (Crusciol, et al., 2009). According to Hasnaa Ghazy's (2021) study, the application of silicate at a rate of 2% yielded the highest grain production and acceptable water productivity.

## Conclusions

The foliar application of potassium silicate to rice plants enhancement tolerant to salt stress by enhancing photosynthesis performance then filled grains and 1000- grain weight as indicator to high seed quality. So, could be suggested that, to get highest seed yield with drainage water should be cultivate Egyptian Hybrid1 or Giza 178 and Sakha 104 varieties under this situation.

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