**Journal of Plant Production**

**Journal homepage & Available online at: www.jpp.journals.ekb.eg**

# Behaviours of some Rice Cultivars Treated with Cycocel under Water Stress Condition

**Abdelmegeed, T. M. * and E. A. Z. ElShamey**

Rice Research Department, Field Crops Research Institute, Agricultural Research Center, Egypt

Cross Mark

## ABSTRACT

To investigate the effect of different intervals of water stress and cycocel (CCC) levels on yield and yield components of some rice cultivars (Giza179 and Sakha108), at the farm of Agricultural Research Station, Sakha, Kafrelsheikh, Egypt, during 2018 and 2019 successive rice seasons, a strip-split plot design with four replicates was used. The treatments included three irrigation intervals ($I_1$:4, $I_2$:8, and $I_3$:12 days intervals and four foliar application levels of cycocel hormone ($T_1$:control; $T_2$:250; $T_3$:500; and $T_4$:750 ppm) on two rice cultivars (Giza179 and Sakha108). It was observed that during the foliar application of chlormequat chloride cycocel (CCC), leaf area index (LAI) and dry matter significantly increased by increasing cycocel levels up to 500 ppm while application of cycocel up to (C4) led to increasing chlorophyll content. Number of panicles $m^{-2}$, number of filled grain $panicle^{-1}$, 1000-grain weight and grain yield significantly increased up to 500 ppm as compared to control and 750 ppm (C4) treatments. At all different water intervals and cycocel interaction, data show that foliar application of cycocel up to 500 ppm may improve growth and yield characters under different irrigation intervals up to irrigation every 12-days. While there was no significant difference between rice cultivars under this study on grain yield, on the other hand, Giza 179 mark superiority at all growth and yield characters than Sakha108 which recorded positive results with cycocel as foliar application. It was concluded that cycocel maybe a good tool for improving rice yield under drought stress.

***Keywords:*** Cycocel, Grain yield, Rice (*Oryza Sativa* L.,), Water Stress, Yield component.

## INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crops, nearly more than half of the world's population depends on rice as staple food, especially in developing countries Rice requires a relatively higher amount of water for its normal growth in comparison with other crops (Pandey and Shukla, 2015). Therefore, water stress is a major factor limiting rice production that causes a great threat to rice production (Fellahi *et al*., 2013). Hence, due to diminishing quantities of water supplies worldwide, screening of rice genotypes for drought tolerance is a useful approach for food security (Serraj *et al*., 2009). Drought is one of the major abiotic stress that affects the rice yield worldwide in the rainfed and upland ecosystems. This is not limited to the arid and semiarid regions, but the irregular distribution of rain may result in yield loss significantly. Stress during the tillering stage negatively affects the effective tiller quantity, flag leaf area and length. However, some cultivars can regain normal growth after stress, (Lanceras *et al*., 2004). The main trait that is selected for drought tolerance is the grain yield under stress. Drought effect seed yield depends on the duration of watering from flowering until physiological maturity (Sakran *et al*., 2020).

Climate change has reduced the amount of water from rainfall and rivers and increased evaporation (Smakhtin, 2004; De Wit and Stankiewicz, 2006). Moreover, (Singh *et al*., 2018) estimated that about 10% of land used for irrigated rice production will have to face water scarcity by 2025. Therefore, it is important to reduce water dependency without affecting grain yield. Irrigation of Giza179 after every 8 days can save water by 23% without affecting yield (9.77 t/ha) (El-Habet, 2014).

Cycocel is a growth regulator, affects the physiological properties of plants under stress conditions and modulates the concentration of plant hormones including gibberellins, cytokinins, abscisic acid and ethylene (Rademacher, 2000). Generally, growth retardants reduce the transpiration rate by retarding leaf growth (Luoranen *et al*., 2002). Application of cycocel in plants may increase the concentration of chlorophyll and carotenoids, accelerate the process of photophosphorylation, elevate the number of chloroplasts, stimulate the photosynthetic rate and photo-assimilates partitioning in plants (Wang *et al*., 2017). Previously it was showed that chlorophyll derivatives act as antioxidants to exclude oxidative DNA degradation and lipid peroxidation both by scavenging free radicals and chelating reactive ions (Hsu *et al*., 2013). Therefore, the cycocel might be a promising candidate for plant yield improvement under stress. However, the detailed biochemical and physiological mechanism behind this phenomenon is not known. Yield in soybean (Singh *et al*., 1987), grams and pigeon pea (Vikhi *et al*., 1983) can be increased by preventing the flower abscission and modified crop canopy with the help of cycocel (2-Chloroethyl, trimethyl ammonium chloride) treatment. It improves the photosynthetic translocation that may be the reason for increased seed protein content (Grewal *et al*., 1993). Therefore, this study was designed to investigate the effect of cycocel (CCC) on two rice cultivars at different growth stages under different water stress.

* **Corresponding author.**
**E-mail address: dr_tmk2002@yahoo.com**
**DOI: 10.21608/jpp.2022.116790.1082**

## MATERIAL AND METHODS

To study the ability of Cycocel for improving rice productivity . Two field experiments were carried out at at the farm of Agricultural Research Station, Sakha, Kafrelsheikh, Egypt, during 2018 and 2019 successive rice seasons, to study the effect of different concentration of cycocel ( T1: control; T2: 250; T3: 500; and T4: 750 ppm) as a foliar application of two rice cultivars (Giza179 and Sakha108) under different water irrigation intervals (I1: 4, I2: 8 and I3: 12 days interval) respectively. The field experiment was carried out in four replicates following the a strip-split design. The irrigation treatment was applied in the vertical plots, rice cultivar in the horizontal and the different cycocel levels in the -sub-plots.

Soil samples were collected from the experimental sites at 0-30 cm depth and its physio-chemical analysis was carried out as shown in table (1) (Bhattarai, 2017). On 10th May of 2018 and 2019, 120 kg/ha pregerminated seeds of rice cultivar were broadcasted in the nursery. About 46% urea (165.0 Kg N/ha), 15% phosphorus single super phosphate (36.89 kg P2O5/ha), and zinc (23.8 kg ZnSO4/ha) were applied to the soil before tillage, according to Rice Research and Training Center recommendations. The germinating seedlings were manually transplanted at age 25 days to the permanent field in 20x20 cm between rows and hills. The sub- plots was 12 m2 with about 2-3 seedlings/hill.

**Table 1. Physiochemical properties of the soil at experimental sites in 2018 and 2019**

| Characters | 2018 | 2019 |
|---|---|---|
| Texture | Clay | Clay |
| Percentage Organic matter | 1.65 | 1.68 |
| Total N (ppm) | 556 | 460 |
| Available P (ppm) | 16 | 14 |
| pH | 7.9 | 8.1 |
| Soluble Cations, meq.L-1 | | |
| Ca++ | 5.10 | 5.30 |
| MG++ | 2.10 | 2.00 |
| K+ | 0.40 | 0.50 |
| Na+ | 12.20 | 14.80 |
| Soluble anion, meq.L-1 | | |
| Co3-- | -- | -- |
| HCo3- | 3.50 | 3.80 |
| Cl- | 14.80 | 15.00 |
| So4-- | 1.30 | 1.20 |
| Some available micro-nutrients (ppm) | | |
| Fe++ | 6.05 | 6.10 |
| Zn++ | 0.88 | 1.13 |
| Mn++ | 3.22 | 3.35 |

Herbicide saturn 50% (4.8. litter/ha) mixed with sand was applied on 7th day of transplantation. The agronomic practices recommended by Rice Research and Training Center (RRTC) were followed throughout the experiment. Growth parameters like chlorophyll content of flag leaf using (SPAD), leaf area index, number of tillers m-2, number of panicles m-2, number of filled grains panicle-1, dry matter (g.m-2), 1000-grain weight (g), and grain yields (t/ha) were estimated, Growth parameters were estimated at growth stage for first two traits and the rest before harvesting directly. All data were statistically analyzed according Duncan's multiple range test for analysis of variance (ANOVA) at confidence levels of 95% (Gomez and Gomez, 1984) by CoStat.

## RESULTS AND DISCUSSION

**Results**

**Leaf area index, cholophyll content and dry matter production:**

Leaf area index, Chlorophyll content in flag leaf and dry matter production showed significant differences in different irrigation intervals in both studied seasons table (2). I1 resulted in highest value of leaf area index, chlorophyll content in flag leaf and dry matter production whereas, lowest value of All traits studied was observed under I3 in both studied seasons. The data showed that the chlorophyll content of flag leaf was significantly different between genotypes during both seasons. Moreover, Data revealed that Giza179 cultivar showed increased LAI and dry matter production compared to Sakha108 in both seasons. While, Sakha108 showed the highest chlorophyll content in flag leaf as compared to Giza179 in both studied seasons. Data showed that cycocel treatment at critical growth stages improved all traits studied (LAI, cholophyll content, dry matter production) of rice plants. Foliar spray of cycocel T3 resulted in significantly increased LAI and dry matter production compared to other cycocel concentrations while maximum chlorophyll content in flag leaf was observed in T4 followed byT3. In contrast, T1 produced the least (table 2).

**Interaction effect**

Results suggested in table (3) that irrigation intervals significantly interact with genotypes. Giza179 showed maximum LAI and dry matter production (DM) while the highest value of cholophyll content was recorded with Sakha 108 in both seasons of study under irrigated treatment I1 followed by I2. Whereas, Sakha108 under I3 lowest LAI, cholophyll content and dry matter production in both seasons of study.

Data arranged in table (4) suggested that LAI and DM significantly improved by the cycocel treatment. The maximum effect was observed by T3 under I1 and I2 during both studied seasons without any significant difference between them, while the lowest LAI and DM was observed by T1 under I3. Data in the same table showed that cholophyll content responsed to cycocel application and recorded the highest value when treated by T4 under different irrigated treatments under this study.

Data presented in Table (5) showed a significant difference in LAI and DM due to cycocel treatment on both genotypes in the year 2018 and 2019. The LAI and DM of both genotypes differed significantly treated with different concentrations of cycocel, where the highest value of LAI and DM was observed under cycocel treatment (T3), while the lowest value of LAI was observed under T1 in both seasons of study. Data indicated that Sakha108 had maximum chlorophyll content in flag leaf when treated with T4 followed by cycocel treatments T3 with the same genotype, while the lowest value of chlorophyll content was noticed in Giza179 when treated without cycocel treatments (T1) in both seasons of study.

**Table 2. Leaf area index (LAI), chlorophyll content, and dry matter of genotypes in response to different irrigation intervals and Cycocel application in 2018 and 2019**

| Treatments | LAI | | Chlorophyll content | | Dry matter | |
|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| Irrigation treatments (A) | | | | | | |
| Every 4days (I1) | 4.478a | 4.724a | 45.56a | 46.25a | 1666.38a 1532.36b | 1669.16a |
| Every 8days (I2) | 4.269b | 4.515b | 44.06b | 44.74b | 1435.23c | 1535.14b |
| Every 12days (I3) | 4.098c | 4.344c | 42.28c | 42.97c | | 1438.01c |
| F Test | ** | ** | ** | ** | ** | ** |
| Genotypes (B) | | | | | | |
| Giza179(V1) | 4.594a | 4.839a | 42.93b | 43.62b | 1597.85a 1491.47b | 1600.62a |
| Sakha108(V2) | 3.970b | 4.216b | 45.00a | 45.69a | | 1494.25b |
| F Test | * | * | ** | ** | ** | ** |
| Cycocel treatments(C) | | | | | | |
| T1 | 3.777d | 4.023d | 42.19d | 42.88d | | 1441.08d |
| T2 | 4.133c | 4.379c | 43.33c | 44.02c | 1438.30d 1508.24c | 1511.01c |
| T3 | 4.743a | 4.988a | 44.91b | 45.60b | 1636.83a 1595.26b | 1639.61a |
| T4 | 4.475b | 4.721b | 45.44a | 46.12a | | 1598.04b |
| F Test | ** | ** | ** | ** | ** | ** |
| Interaction: | | | | | | |
| A*B | * | * | * | * | * | * |
| A*C | * | * | * | * | * | * |
| B*C | ** | ** | ** | ** | ** | ** |
| A*B*C | NS | NS | NS | NS | NS | NS |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation every 4-days; I2: Irrigation every 8-days; I3: Irrigation every 12-days; V1:Giza179; V2: Sakha108; T1: Control (Tap water only); T2: 250 ppm of Cycocel; T3: 500 ppm of Cycocel; T4: 750 ppm of cycocel.**

**Table 3. The effect of irrigation intervals and genotypes V1 and V2 on leaf area index (LAI), Chlorophyll content and dry matter Production (g/m2) (DM) in 2018 and 2019 seasons**

| | | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|---|
| | | LAI | Chlorophyll content | DM | LAI | Chlorophyll content | DM |
| I1 | V1 | 4.864a | 44.23c | 1702.58a | 5.110a 4.337d | 44.91c | 1705.36a |
| | V2 | 4.091d | 46.89a | 1630.19b | | 47.58a | 1632.96b |
| I2 | V1 | 4.551b | 42.78d | 1571.17c | 4.797b 4.234e | 43.46d | 1573.95c |
| | V2 | 3.988e | 45.34b | 1493.56e | | 46.02b | 1496.34e |
| I3 | V1 | 4.366c | 41.80e | 1519.79d | 4.612c | 42.48e | 1522.57d |
| | V2 | 3.831f | 42.77d | 1350.67f | 4.077f | 43.46d | 1353.45f |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation interval of 4-days; I2: Irrigation interval of8-days; I3: Irrigation interval of 12-days; V1:Giza179; V2: Sakha108.**

**Table 4. The effect of irrigation intervals and Cycocel treatments on leaf area index, chlorophyll content and dry matter production (g m-2) (DM) during 2018 and 2019 seasons**

| Treatments | | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|---|
| | | LAI | Chlorophyll content | DM | LAI | Chlorophyll content | DM |
| I1 | T1 | 4.001f | 43.47f | 1606.58f | 4.247f | 44.16f | 1609.36f |
| | T2 | 4.275d | 44.84e | 1657.83c | 4.521d | 45.52e | 1660.61c |
| | T3 | 4.903a | 46.34b | 1719.33a | 5.148a | 47.02b | 1722.11a |
| | T4 | 4.733b | 47.60a | 1681.79b | 4.979b | 48.29a | 1684.57b |
| I2 | T1 | 3.700g | 42.30i | 1376.17j | 3.946g | 42.99h | 1378.94j |
| | T2 | 4.120e | 43.32g | 1506.75h | 4.365e | 44.01g | 1509.53h |
| | T3 | 4.853a | 45.17d | 1630.88d | 5.099a | 45.85d | 1633.65d |
| | T4 | 4.405c | 45.43c | 1615.67e | 4.651c | 46.12c | 1618.44e |
| I3 | T1 | 3.629g | 40.79k | 1332.17l | 3.875g | 41.48j | 1334.94l |
| | T2 | 4.004f | 41.83j | 1360.13k | 4.250f | 42.52i | 1362.90k |
| | T3 | 4.472c | 43.23h | 1560.30g | 4.718c | 43.92g | 1563.07g |
| | T4 | 4.287d | 43.28gh | 1488.33i | 4.533d | 43.96g | 1491.11i |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation interval of4-days; I2: Irrigation interval of 8-days; I3: Irrigation interval of 12-days; T1: Control (Tap water only); T2: 250 ppm of Cycocel; T3: 500 ppm of Cycocel; T4: 750 ppm of cycocel.**

**Table 5. Leaf area index (LAI), chlorophyll content and dry matter production as a result of interaction between genotypes and Cycocel treatments in 2018 and 2019**

| Treatments | | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|---|
| | | LAI | Chlorophyll content | DM | LAI | Chlorophyll content | DM |
| V1 | T1 | 3.919f | 41.37h | 1451.58e | 4.165f | 42.06h | 1454.36e |
| | T2 | 4.541c | 41.63g | 1641.11b | 4.787c | 42.32g | 1643.89b |
| | T3 | 5.169a | 44.11e | 1654.97a | 5.415a | 44.80e | 1657.75a |
| | T4 | 4.745b | 44.61d | 1643.72b | 4.991b | 45.30d | 1646.50b |
| V2 | T1 | 3.635h | 43.00f | 1425.03f | 3.881h | 43.69f | 1427.81f |
| | T2 | 3.725g | 45.02c | 1375.36g | 3.971g | 45.71c | 1378.14g |
| | T3 | 4.316d | 45.71b | 1618.69c | 4.562d | 46.40b | 1621.47c |
| | T4 | 4.205e | 46.26a | 1546.80d | 4.451e | 46.95a | 1549.58d |

**Where:V1:Giza179; V2: Sakha108; T1: Control (Tap water only); T2: 250 ppm of Cycocel; T3: 500 ppm of Cycocel; T4: 750 ppm of cycocel.**

**Number of panicles m-2, No. of filled grain panicle-1 and 1000-grain weight g-1:**

Data in table (6) revealed statistical differences between the irrigation intervals on number of panicles m-2, number of filled grain panicle-1 and 1000-grain weight g-1 at harvest in both studied seasons. Irrigation interval I1 showed a marked superiority in all studied traits under this study and produce the highest values and I3 resulted in lowest number of panicles m-2, number of filled grain panicle-1 and 1000-grain weight g-1 at harvest in both seasons of study. This might be due to the highest number of tillers under irrigation every 4-days.

Data in table (6) revealed significant differences between Genotypes in terms of panicles/m2, filled grain panicle-1 and 1000-grain weight g-1 at harvest in both studied seasons. Among Genotypes, Giza179 showed superiority in number of panicles/m2 and filled grain panicle-1 in both studied seasons compared to Sakha108 which gave highest value of 1000-grain weight g-1 in both studied seasons. This result could be due to the superiority of Giza179 in tillering ability comparing with Sakha108 rice cultivar.

Cycocel treatments at different growth stages significantly increased number of panicles m-2, filled grain panicle-1 and 1000-grain weight g-1 in both studied seasons whereas, differences among different concentrations of cycocel treatment were observed (table 6). Results demonstrated that the application of cycocel T3 produced maximum number of panicles m-2 and filled grain panicle-1 followed by T4. Also, in this table results affirmed that 1000-grain weight recorded nearly the same value between T3 and T4 without any statistical significant in this table under this study. While the lowest number of panicles m-2 , filled grain panicle-1 and 1000-grain weight g-1 were recorded under control (T1). The results remain consistent during the two studied seasons. Therefore, cycocel may be a good candidate for improving plant yield under stress conditions.

**Table 6. Number of panicles m-2, Number of filled grain panicle-1, 1000-grain weight g-1 and grain yield at harvest of some genotypes in response to irrigation intervals and Cycocel foliar application in 2018 and 2019 seasons**

| Treatments | No. of panicles m-2 | | No. of filled grain panicle-1 | | 1000-grain weight/g | | Grain yield T ha-1 | |
|---|---|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| Irrigation intervals (A) | | | | | | | | |
| Every 4 days (I1) | 455.56a | 458.02a | 145.54a | 147.87a | 27.99a | 28.11a | 10.63a | 10.88a |
| Every 8 days (I2) | 427.81b | 430.27b | 143.69b | 146.02b | 27.60ab | 27.72b | 10.27a | 10.52a |
| Every 12days (I3) | 405.84c | 408.30c | 142.16c | 144.49c | 27.32b | 27.45c | 9.49b | 9.73b |
| F Test | ** | ** | * | * | * | * | * | * |
| Genotypes (B) | | | | | | | | |
| Giza179 | 442.52a | 444.98a | 145.88a | 148.21a | 27.03b | 27.15b | 10.07a | 10.31a |
| Sakha108 | 416.95b | 419.41b | 141.72b | 144.05b | 28.24a | 28.36a | 10.19a | 10.44a |
| F Test | * | * | * | * | * | ** | NS | NS |
| Cycocel Treatments (C) | | | | | | | | |
| T1 | 374.88d | 377.34d | 140.77d | 143.10d | 26.70c | 26.82c | 8.82d | 9.06d |
| T2 | 411.17c | 413.63c | 142.60c | 144.93c | 27.30b | 27.42b | 9.37c | 9.62c |
| T3 | 477.21a | 479.67a | 146.55a | 148.88a | 28.17a | 28.29a | 11.41a | 11.65a |
| T4 | 455.70b | 458.16b | 145.27b | 147.60b | 28.38a | 28.50a | 10.93b | 11.17b |
| F Test | ** | ** | ** | ** | * | * | ** | ** |
| Interaction: | | | | | | | | |
| A*B | * | * | * | * | * | * | * | * |
| A*C | * | * | * | * | * | * | * | * |
| B*C | * | * | * | * | * | * | * | * |
| A*B*C | NS | NS | NS | NS | NS | NS | NS | NS |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation every 4-days; I2: Irrigation every 8-days; I3: Irrigation every 12-days; V1:Giza179; V2: Sakha108; T1: Control (Tap water only); T2: 250 ppm of Cycocel; T3: 500 ppm of Cycocel; T4: 750 ppm of cycocel.**

**Interaction effect**

Data in table 7 revealed that interaction between irrigation intervals and Genotypes significantly affect number of panicles m-2, filled grain panicle-1 and 1000-grain weight g-1 in both seasons. The best combination resulted highest panicles m-2 and filled grain panicle-1 were Giza179 under I1 followed Sakha 108 under I1 in the both studied seasons. The combination resulted in lowest panicles m-2 was Sakha108 under I3. On the other hand, Sakha108 rice variety gave the highest value of 1000-grain weight under irrigation interval I1 followed by I2 whereas, Giza 179 showed minimum 1000-grain weight under I3 in both seasons.

**Table 7. Number of panicles m-2, Number of filled grain panicle-1, 1000-grain weight/g and grain yield (t ha-1) at harvest in response to interaction between irrigation intervals and genotypes in 2018 and 2019 seasons**

| Treatments | | No. of panicles m-2 | | No. filled grain panicle-1 | | 1000-grain weight/g | | Grain yield (t ha-1) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| I1 | V1 | 470.50a | 472.96a | 146.75a | 149.08a | 27.31cd | 27.43d | 10.52a | 10.76a |
| | V2 | 440.63b | 443.09b | 144.33c | 146.66d | 28.68a | 28.80a | 10.75a | 10.99a |
| I2 | V1 | 438.31c | 440.77b | 145.98b | 148.31b | 27.03d | 27.15e | 10.15ab | 10.40ab |
| | V2 | 417.30e | 419.76c | 141.40d | 143.73e | 28.18ab | 28.30b | 10.40a | 10.64a |
| I3 | V1 | 418.75d | 421.21c | 144.90c | 147.23c 141.76f | 26.78d | 26.89f | 9.55b | 9.80bc |
| | V2 | 392.94f | 395.40d | 139.43e | | 27.87bc | 27.99c | 9.43b | 9.68c |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation every 4-days; I2: Irrigation every 8-days; I3: Irrigation every 12-days; V1:Giza179; V2: Sakha108**

Results affirmed highly significant interaction differences between irrigation intervals and different levels of cycocel treatments in terms of number of panicles m-2 , number of filled grain panicle-1 and 1000-grain weight/g in the two studied seasons (table 8). Data indicated that cycocel treatment T3 resulted in highest number of panicles m-2 at different irrigation intervals followed by T4. While the lowest number of panicles m-2 was observed under I3 with control treatment T1. The association of filled grains panicle-1 with irrigation intervals and cycocel application is present in table (8). Data demonstrated that cycocel application T3 under I1 produced maximum number of filled grains panicle-1 (first rank) followed by cycocel application T4 under I1. Whereas, the lowest number of filled grain panicle-1 was found in cycocel treatment T1 under I3. It showed that cycocel application can improve filled grains panicle-1, due to increased photosynthetic rate.

Data indicated that cycocel application T3 and T4 resulted in nearly the same 1000-grain weight under all tested treatment of irrigation intervals without any significant differences among each other, while the irrigation interval I3 gave less 1000-grain weight under control treatment T1 (tap water only) in both seasons of study.

**Table 8. Number of panicles m-2, Number of filled grain panicle-1, 1000-grain weight/g and grain yield (t ha-1) at harvest as affected by the interaction between irrigation intervals and cycocel treatments in 2018 and 2019 seasons**

| Treatments | | No. of panicles m-2 | | No. filled grain panicle-1 | | 1000-grain weight/g | | Grain yield (t ha-1) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| I1 | T1 | 398.75i | 401.21h | 142.70g | 145.03h | 27.10cd | 27.22cd | 9.24de | 9.48de |
| | T2 | 433.50f | 435.96f | 144.00ef | 146.33f | 27.85a-c | 27.97a-c | 10.04cd | 10.28cd |
| | T3 | 505.00a | 507.46a | 148.60a | 150.93a | 28.50a | 28.62a | 11.92a | 12.16a |
| | T4 | 485.00b | 487.46b | 146.85b | 149.18b | 28.52a | 28.64a | 11.33ab | 11.57ab |
| I2 | T1 | 375.00k | 377.46j | 140.40i | 142.73j | 26.50d | 26.62d | 9.05ef | 9.29e |
| | T2 | 415.00h | 417.46g | 142.50g | 144.83h | 27.26b-d | 27.38b-d | 9.85cde | 10.09cde |
| | T3 | 471.63c | 474.09c | 146.25bc | 148.58c | 28.15ab | 28.27ab | 11.24ab | 11.48ab |
| | T4 | 449.60e | 452.06e | 145.60cd | 147.93d | 28.50a | 28.62a | 10.95b | 11.19b |
| I3 | T1 | 350.88l | 353.34k | 139.20j | 141.53k | 26.50d | 26.62d | 8.17g | 8.42f |
| | T2 | 385.00j | 387.46i | 141.30h | 143.63i | 26.80d | 26.92d | 8.23fg | 8.48f |
| | T3 | 455.00d | 457.46d | 144.80de | 147.13e | 27.87a-c | 27.99a-c | 11.06ab | 11.29ab |
| | T4 | 432.50g | 434.96f | 143.35fg | 145.68g | 28.13ab | 28.25ab | 10.50bc | 10.74bc |

**Means followed by a common letter are not significantly different at the 5% level by DMRT.**
**Where: I1: Irrigation every 4-days; I2: Irrigation every 8-days; I3: Irrigation every 12-days; V1:Giza179; V2: Sakha108; T1: Control (Tap water only); T2: 250 ppm of Cycocel; T3: 500 ppm of Cycocel; T4: 750 ppm of cycocel.**

Interaction between Genotypes and different levels of cycocel treatments affects number of panicles/m2 , number of filled grain panicle-1 and 1000-grain weight/g in both studied seasons (Table 9). Giza179 rice cultivar showed highest number of panicles m-2 , and number of filled grain panicle-1 in both studied of seasons with cycocel treatment T3 followed by Sakha108 at the same level of cycocel treatments. Whereas, Sakha108 showed lowest number of panicles m-2 under cycocel treatments (T1) in the two studied seasons. Data displayed in Table (9) indicated that cycocel application T2, T3 and T4 showed the highest 1000-grain weight with Sakha108 rice cultivar without any significant differences among each other, while Giza179 gave less 1000-grain weight under control treatment T1 (tap water only) in both seasons of study.

**Table 9. Number of panicles m-2 at harvest as affected by the interaction between genotypes and Cycocel treatments in 2018 and 2019 seasons**

| Treatments | | No. of panicles m-2 | | No. filled grain panicle-1 | | 1000-grain weight/g | | Grain yield (t ha-1) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| V1 | T1 | 398.33g | 400.79f | 143.03d | 145.36d | 26.20d | 26.32d | 8.79c | 9.04d |
| | T2 | 419.00e | 421.46d | 144.77c | 147.10c | 26.40d | 26.52d | 8.92c | 9.17d |
| | T3 | 486.08a | 488.54a | 148.47a | 150.79a | 27.67bc | 27.79bc | 11.52a | 11.76a |
| | T4 | 466.67c | 469.13b | 147.23b | 149.56b | 27.87bc | 27.99bc | 11.05a | 11.29ab |
| V2 | T1 | 351.42h | 353.88g | 138.50f | 140.80f | 27.20c | 27.32c | 8.85c | 9.09d |
| | T2 | 403.33f | 405.79e | 140.43e | 142.76e | 28.20ab | 28.33ab | 9.83b | 10.07c |
| | T3 | 468.33b | 470.79b | 144.63c | 146.96c | 28.68a | 28.80a | 11.29a | 11.53ab |
| | T4 | 444.73d | 447.19c | 143.30d | 145.63d | 28.89a | 29.01a | 10.80a | 11.05b |

### Grain yield t ha-1

Data in table (6) indicated that irrigation interval had a significant effect on rice grain yield in both seasons of study. Irrigation interval I1 and I2 gave the highest grain yield without significant difference between them in the two seasons of study while I3 gave lowest grain yield in both seasons of study.

Data listed in table (6) indicated highly significant differences among different concentrations of cycocel treatments in grain yield in both seasons of study. cycocel treatment T3 markedly surpassed the other cycocel treatments under study in grain yield. On the other hand, the lowest grain yield was observed when plants treated without cycocel application T1.

### Interaction effect

Data in Table (7) asserted that there were significant differences in grain yield was observed in response to irrigation intervals and two genotypes. Under I1 and I2 genotypes produced more grain yield without any significance between them. Whereas, I3 had the lowest grain yield in both seasons of study.

Data indicated that cycocel application T3 under any irrigation intervals gave maximum grain yield without significant difference among them in the two studied seasons followed by cycocel treatments T4 under irrigation interval I1 (table 8). On the other hand, the lowest grain yield was observed when rice plants treated with tap water only (T1) under irrigated interval I3 (table 8).

Data in Table (9) and asserted that there was a highly significant difference in the interaction between the different genotypes and cycocel treatments regarding grain yield recorded in both seasons. No significant differences in grain yield of Giza179 and Sakha108 were observed when treated with cycocel with 500 ppm (T3) and 750 ppm (T4). Both genotypes under T1 treatment gave nearly a similar grain weight and recorded the lowest grain yield under this study.

Exchanges (%) of grain yield as influenced by different water intervals and various cycocel levels were present in Fig (1). Spraying cycocel with 500 ppm (T3) produced the peak value of exchange (%) in grain yield under all irrigation intervals treatments. Also, with increasing the period between water intervals, the effect of cycocel increasing and exchange (%) in grain yield increasing. We have shown that during drought stress, the increasing concentration of cycocel increases the biomass. However, cycocel concentration 500 ppm may reduce grain yield, possibly due to cycocel mediated stomal closure to prevent wilting.

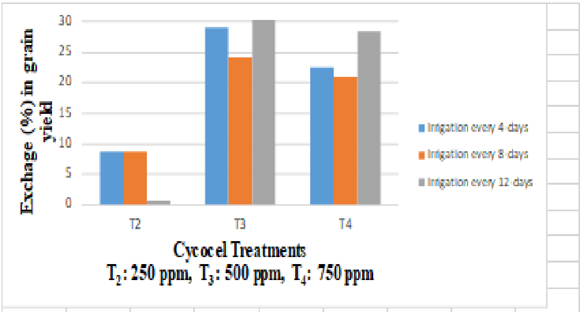


**Fig 1. Exchange (%) in grain yield as influenced by different doses of cycocel under different water intervals in the two seasons.**

## Discussion

It is clear from data introduced in this investigation that foliar application levels of cycocel hormone had huge impact on vegetative and yield component characters as; leaf area index (LAI), dry matter, chlorophyll content, number of panicles m-2, number of filled grain panicle-1, 1000-grain weight, and grain yield. It was observed that during the foliar application of chlormequat chloride (CC), The increasing in the leaf area index might be due to the vigorous growth of Giza179 especially under I1 and I2 which increase the number of tillers and consequently increase its canopy resulted in an increased leaf area index. leaf area index (LAI) and dry matter significantly increased by increasing cycocel levels up to 500 ppm, these results are in agreement with that obtained by (Kumari, 2017) (Kumar *et al.*, 2018) and (Seyed Sharifi and Khalilzadeh, 2018). It means that application of cycocel as foliar spray under water stress increases the number of tillers and leave area and resulted increased in LAI (photosynthetic area). These results are in compatibility with that obtained by (El-Refaee *et al.*, 2012) and (Heidari and Golpayegani, 2012). For chlorophyll content, data suggests that the application of cycocel treatments is beneficial for improving the viability and chlorophyll content of flag leaf hence accelerate the process of photo-phosphorylation, stimulate the photosynthetic rate and photo-assimilates partitioning in plants (Wang and Xiao, 2009), (Wu *et al.*, 2018) and (Zheng *et al.*, 2020). The increased chlorophyll index in the cycocel treated plants might also be due to the influence of cycocel on improving the synthesis of enzymes and soluble proteins, chlorophyll synthesis by higher enzyme activity, retardation of leaf senescence and avoiding chlorophyll degradation (Osman, 2014). These results are in coincidence with that reported by (Heidari and Golpayegani, 2012); (El-Habet, 2014) and (Zheng *et al.*, 2020). For dry matter content, the increase in dry matter content under I1 might be due to the increased tillers, number and area of leaves that results in increased photosynthesis and dry matter accumulation. These data indicated that the superiority of Giza179 in dry matter accumulation than Sakha108 may be due to vigorous vegetative growth, high vegetative growth rate, and high leaf area index result in high photosynthesis in both pre/and post-following.

For number of panicles m-2 remain consistent during the two studied seasons. Therefore, cycocel hormone may be a good candidate for improving plant yield under stress conditions. This might be due to the highest number of tillers under irrigation every 4-days. These results are in confirmed by (Escasinas and Zamora, 2011) and (El-Refaee *et al.*, 2012) and were in good coincidence with that reported by (Kumari, 2017), (Abdel-Megeed *et al.*, 2017)and (Bhattarai, 2017).

Number of Filled grains panicle-1, data indicated that Giza179 showed filled grains panicle-1 than Sakha108 in the two seasons of study. It might be due to the highest LAI as a photosynthesis area and dry matter content in rice cultivar. It could be due to the increase in photosynthesis under I1 than I2 because of the optimum light penetration through the rice canopy which produced more photosynthesis growth stages resulted in higher dry matter accumulation before flowering and high photosynthesis metabolites during filling period resulted in higher filling grains rice. These are the findings as reported by (Hashem *et al.*, 2016) and (Abdel-Megeed *et al.*, 2017). It means that the application of cycocel may aid in achieving optimum photosynthesis, increased number of filled grains, improved sink size and capacity during both growth stages. The same is reported by (Latifkar and Mojaddam, 2014); (Bhattarai, 2017) and (Kumar *et al.*, 2018). Crop water uptake ability before anthesis can have major impact on crop growth because grain number and grain weight are set during this phase. Furthermore, final grain weight is related to grain filling and their interactions (Sadras and Egli, 2008). The increased photosynthesis rate streams the translocated metabolites from source to sink which increases filling processes. Environmental factors effects grain filling duration more than grain filling rate (Santiveri *et al.*, 2002). These results are concurrent with those reported by (Attia, 2004); (Latifkar *et al.*, 2014) and (Bhattarai, 2017). Sink size was increased before and after the flowering and its positive feedback effect on photosynthetic rate and sap production rate made possible to fill the additional grains (Waddington and Cartwright, 1988). Similar observation is reported for wheat cultivars that a combination of 80 kg ha-1 nitrogen and cycocel may increase radiation use efficiency (Khalilzadeh *et al*., 2016). Cycocel is also known to increase the number of grains per plant (Bhattarai, 2017). Cycocel application is responsible for increased photosynthetic rate, viability of flag leaf, and streaming of metabolites directly from the source to sink which results in heavy grain weight. The weight of 1000 grains depends on plant genotype and initial carbohydrate reserves, these data are in coincidence with that recorded by (Latifkar *et al*., 2014) and (Bhattarai, 2017).

It is suggested that for grain yield t ha-1, if there is a restricted water supply during grain filling stage, wheat plant depends more on stem reserves than the current photosynthesis (Ehdaie *et al*., 2008). This is because the stress limits photosynthesis and promotes leaf senescence (Martinez *et al*., 2003), these findings are in good compatibility with that recorded by (Abdel-Megeed *et al*., 2017). In this study, we found that chlormequat chloride is beneficial for increasing grain yield but plant height was negatively affected. The yield may have increased due to more successful tillers and greater number of grains in ears. It seems that plants have readjusted the sap distribution for height to grains. However, the decrease plant height is linked with many beneficial traits like resistance against lodging (Mohaghegh and Imam, 2007). Meanwhile, nitrogen manure is needed for dry matter production for increasing the grain yield. When photosynthetic activity is depressed by drought or salinity after anthesis, grain filling becomes more dependent on mobilized stem reserves, which may then represent 22 to 80% of dry matter accumulation in the grain (Zheng *et al*., 2020).

We can conclude that the cycocel is responsible for increased photosynthesis, growth, the viability of flag leaf and streaming of sap from source to sink directly to increase grain weight. The effective tillers and increased number of grain per ear may also have role in increasing the yield. These results are in concert with those obtained by (Kumar *et al*., 2018) and (Khalilzadeh *et al*., 2016). Cycocel meditated increased grain yield was resulted from increased effective tillers and leaf surface and ultimately enhanced the photosynthesis, assimilation, translocation and stream of the sap towards grains (Sharif *et al*., 2007). It was reported that the combination of chlormequat chloride with cycocel decreases the plant height by 23% along with significant increase in grain yield (Singh *et al*., 2018), whereas cycocel alone can increase Ghods wheat grain yield by 12% (Emam and Niknejad, 2011). These results are in coincidence with those reports by (PirastehAnosheh *et al*., 2016); (Kumar *et al*., 2018) and (Seyed Sharifi *et al*., 2018). However, at the same time, closed stomata reduce the carbon dioxide penetration, necessary for photosynthesis hence decreases the dry mass. Another pathway for reduced biomass results from cycocel mediated inhibition of Gibberellic Acid (GA3) biosynthesis (Hamad *et al*., 2015). Cycocel inhibits the growth of the shoots and shunts the growing activity toward the roots. So, the grain yield increase may be the result of osmotic regulation and increased soluble potassium. Cycocel dramatically changes root morphology, by increasing root diameter and decreasing the length (Skene and Mullins, 1967). So, a thicker and shorter root of Giza 179 may provide tolerance against drought (Sakran *et al*., 2020).

## CONCLUSION

The importance of cycocel application was evident from the data under environmental stress conditions. The highest impact of cycocel was found with irrigation every 12 days at the concentration of 500 ppm for rice cultivar Giza 179. More research needs to be focused on cycocel induced stress tolerance under the environmental condition of Kaferelsheikh Governorate, Egypt. .

## REFERENCES


Abdel-Megeed, T., El-habet, H.B., Hashem, I. and Badawy, S.A.J.J.o.P.P., 2017. Impact of Some Plant Growth Regulating Substances on the Yield and its Components of Giza179 and Giza177 Rice Cultivars under Different Irrigation Interval Treatments. 8(3): 369-379.

Attia, A., 2004. Physiological studies on some ornamental bulbs, Ph. D. Thesis, Derpartment of Horticulture, Kafr El-Sheik, Tanta University.

Bhattarai, P., 2017. Effects of plant growth regulators on growth and yield of pre-basic seed potato production under glasshouse condition. SAARC Journal of Agriculture, 15(1): 149-160.

De Wit, M. and Stankiewicz, J., 2006. Changes in surface water supply across Africa with predicted climate change. Science, 311(5769): 1917-1921.

Ehdaie, B., Alloush, G. and Waines, J., 2008. Genotypic variation in linear rate of grain growth and contribution of stem reserves to grain yield in wheat. Field Crops Research, 106(1): 34-43.

El-Habet, H.B., 2014. Irrigation regime and potassium levels effects on yield of some rice genotypes, water use efficiency (WUE) and economic returns. Journal of Plant Production, 5(3): 383-399.

El-Refaee, I., Gorgy, R. and Metwally, T., 2012. Response of some rice cultivars to plant spacing for improving grain yield and water productivity under different irrigation intervals. Alex. J. Agric. Res, 57(1): 1-15.

Emam, Y. and Niknejad, M., 2011. An introduction to the physiology of crop yield. Translated): 591.

Escasinas, R.O. and Zamora, O.B., 2011. Agronomic response of lowland rice PSB Rc 18 (Oryza sativa L.) to different water, spacing and nutrient management. Philipp. J. Crop Sci, 36(1): 37-46.

Fellahi, Z., Hannachi, A., Bouzerzour, H. and Boutekrabt, A., 2013. Correlation between traits and path analysis coefficient for grain yield and other quantitative traits in bread wheat under semi arid conditions. Journal of Agriculture and Sustainability, 3(1).

Gomez, K.A. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley & Sons.

Grewal, H., Kolar, J., Cheema, S. and Singh, G., 1993. Studies on the use of growth regulators in relation to nitrogen for enhancing sink capacity and yield of gobhi sarson (Brassica napus). Indian Journal of plant physiology.

Hamad, H.S., Gaballah, M., El Sayed, M. and El Shamey, E., 2015. Effect of GA3 doses and row ratio on cytoplasmic male sterile line ir69625a seed production in hybrid rice. Egypt. J. Plant Breed, 19(3): 155-167.

Heidari, M. and Golpayegani, A., 2012. Effects of water stress and inoculation with plant growth promoting rhizobacteria (PGPR) on antioxidant status and photosynthetic pigments in basil (Ocimum basilicum L.). Journal of the Saudi Society of Agricultural Sciences, 11(1): 57-61.

Hsu, C.-Y., Chao, P.-Y., Hu, S.-P. and Yang, C.-M., 2013. The antioxidant and free radical scavenging activities of chlorophylls and pheophytins.

Khalilzadeh, R., Seyed Sharifi, R. and Jalilian, J., 2016. Antioxidant status and physiological responses of wheat (Triticum aestivum L.) to cycocel application and bio fertilizers under water limitation condition. Journal of Plant Interactions, 11(1): 130-137.

Kumar, P., Haldankar, P. and Haldavanekar, P., 2018. Study on effect of plant growth regulators on flowering, yield and quality aspects of summer okra (Abelmoschus esculentus L. Moench) Var. Varsha Uphar.

Kumari, S., 2017. Effect of Kinetin (6-FAP) and Cycocel (CCC) on Growth, Metabolism and Cellular Organelles in Pearl Millet (Pennisetum glaucum) Under Water Stress. Int. J. Curr. Microbiol. App. Sci, 6(8): 2711-2719.

Lanceras, J.C., Pantuwan, G., Jongdee, B. and Toojinda, T., 2004. Quantitative trait loci associated with drought tolerance at reproductive stage in rice. Plant physiology, 135(1): 384-399.

Latifkar, M. and Mojaddam, M., 2014. The effect of application time of cycocel hormone and plant density on growth indices and grain yield of wheat (Chamraan cultivar) in Ahvaz weather conditions. Indian Journal of Fundamental and Applied Life Sciences, 4(4): 274-283.

Luoranen, J., Rikala, R. and Aphalo, P.J., 2002. Effect of CCC and daminozide on growth of silver birch container seedlings during three years after spraying. New Forests, 23(1): 71-80.

Martinez, D.E., Luquez, V.M., Bartoli, C.G. and Guiamet, J.J., 2003. Persistence of photosynthetic components and photochemical efficiency in ears of water-stressed wheat (Triticum aestivum). Physiologia Plantarum, 119(4): 519-525.

Mohaghegh, R. and Imam, Y., 2007. Study on the effect of cycocell hormone on two cultivars of fall rapeseed, Thesis for MS in Shiraz University.

Osman, A.R., 2014. Improving some quantitative and qualitative characteristics of Solidago canadensis" Tara" using cycocel and planting density under drip irrigation and lighting systems. Life Science Journal, 11(6): 110-118.

Pandey, V. and Shukla, A., 2015. Acclimation and tolerance strategies of rice under drought stress. Rice Science, 22(4): 147-161.

Rademacher, W., 2000. Growth retardants: effects on gibberellin biosynthesis and other metabolic pathways. Annual review of plant biology, 51(1): 501-531.

Sadras, V.O. and Egli, D., 2008. Seed size variation in grain crops: allometric relationships between rate and duration of seed growth. Crop Science, 48(2): 408-416.

Sakran, R., El Shamey, E. and Anis, G., 2020. Diallel Analysis of Different Rice Genotypes under Water Deficiency Conditions and Assessing Genetic Diversity Using SSR Markers. Journal of Plant Production, 11(12): 1319-1332.

Santiveri, F., Royo, C. and Romagosa, I., 2002. Patterns of grain filling of spring and winter hexaploid triticales. European Journal of Agronomy, 16(3): 219-230.

Serraj, R. *et al*., 2009. Improvement of drought resistance in rice. Advances in agronomy, 103: 41-99.

Seyed Sharifi, R. and Khalilzadeh, R., 2018. Effects of cycocel on growth, some physiological traits and yield of wheat (Triticum aestivum L.) under salt stress. Journal of Plant Physiology and Breeding, 8(1): 11-23.

Sharif, S., Saffari, M. and Emam, Y., 2007. The effect of drought stress and cycocel on barley yield (cv. Valfajr). Journal of Science and Technology of Agriculture and Natural Resources.

Singh, S. *et al*., 2018. Effect of drought stress on yield and yield components of rice (Oryza sativa L.) genotypes. Int. J. Curr. Microbiol. Appl. Sci, 7: 2752-2759.

Singh, S., Rachie, K.O. and Dashiell, K., 1987. Soybeans for the tropics: research, production and utilization.

Skene, K. and Mullins, M., 1967. Effect of CCC on the growth of roots of Vitis vinifera L. Planta, 77(2): 157-163.

Smakhtin, V., 2004. Taking into account environmental water requirements in global-scale water resources assessments, 2. Iwmi.

Vikhi, S., Bangal, D. and Patil, V., 1983. Effect of growth regulators and urea on pod number of pigeonpea cv. 148. International Pigeonpea Newsletter, 2: 39-40.

Waddington, S. and Cartwright, P., 1988. Pre-maturity gradients in shoot size and in number and size of florets for spring barley treated with mepiquat chloride. The Journal of Agricultural Science, 110(3): 633-639.

Wang, H. and Xiao, L., 2009. Effects of chlorocholine chloride on phytohormones and photosynthetic characteristics in potato (Solanum tuberosum L.). Journal of Plant Growth Regulation, 28(1): 21-27.

Wang, L., Wang, S., Chen, W., Li, H. and Deng, X., 2017. Physiological mechanisms contributing to increased water-use efficiency in winter wheat under organic fertilization. PLoS One, 12(6): e0180205.

Wu, X., Wang, W., Xie, X., Yin, C. and Xie, K., 2018. Photosynthetic and yield responses of rice (Oryza sativa L.) to different water management strategies in subtropical China. Photosynthetica, 56(4): 1031-1038.

Zheng, C. *et al*., 2020. Agronomic growth performance of super rice under water-saving irrigation methods with different water-controlled thresholds in different growth stages. Agronomy, 10(2): 239.

## تقييم أداء بعض أصناف الأرز المعامل بهرمون السيكوسيل تحت ظروف الأجهاد المائى

**طاهر محمد كامل عبدالمجيد و عصام عادل ذكي الشامي**

**قسم بحوث الارز - معهد بحوث المحاصيل الحقليه- مركز البحوث الزراعية**

لدراسة تأثير الفترات المختلفة من الأجهاد المائى ومستويات هرمون السيكوسيل على المحصول ومكوناته لبعض التراكيب الوراثية من الأصناف المنزرعة من نباتات الأرز أصناف جيزة 179 و سخا 108، تم أجراء التجربة البحثية بنظام القطع المنشقة فى نظام قطاعات كاملة العشوائية بأربعة مكررات. أشتملت المعاملات على ثلاث فترات رى (4، 8، 12 يوما) وأربعة مستويات من الرش الورقى لهرمون السيكوسيل (كنترول ، 250 ، 500، 750 جزء فى المليون) على الصنفين المنزرعين جيزة 179 و سخا 108. لوحظ أنة خلال الأستخدام الورقى لكلوريد الكلورميكوات (CC) ، زاد دليل ورقة العلم (LAI) والمادة الجافة بشكل كبير عن طريق زيادة مستويات هرمون السيكوسيل حتى 500 جزء فى المليون بينما أدى الرش السيكوسيل حتى (C4) إلى زيادة محتوى الكلوروفيل. بينما زادت عدد السنابل لكل متر مربع وعدد الحبوب الممتلئة ووزن ال 1000 حبة زيادة معنوية عند مستوى أضافة 500 جزء فى المليون مقارنة بالمعاملة الكنترول والمعاملة 750 جزء فى المليون. C4 فى جميع فترات المياة المختلفة وتفاعل السيكوسيل، أظهرت البيانات أن التطبيق الورقى للسيكوسيل حتى 500 جزء فى المليون قد يحسن النمو وخصائص المحصول تحت فترات رى مختلفه حتى الرى كل 12 يوما. بينما لم يكن هناك فرق معنوى بين أصناف الأرز فى هذة الدراسة على محصول الحبوب، من ناحية أخرى سجل الصنف جيزة 179 تفوقا ملحوظا فى جميع صفات النمو والمحصول مقارنة بالصنف سخا 108 الذى سجل نتائج إيجابية بأستخدام السيكوسيل كتطبيق ورقى، وأوصت التجربة البحثية الى أن رش نباتات الأرز بمركب السيكوسيل ربما يكون وسيلة جيدة لتحسين محصول الأرز تحت ظروف الجفاف فى مصر .