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Impact of Some Plant Growth Regulating Substances on the Yield and its Components of Giza179 and Giza177 Rice Cultivars under Different Irrigation Interval Treatments.

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ABSTRACT

One of the main problems of lowland rice cultivation and production is the shortage of irrigation water, which effects the vegetative growth rate and the amount of yield and its component. In this study, afield experiment was conducted to find out the impact of some plant growth regulating substance on rice cultivars namely; Giza179 cultivar and Giza177 cultivar grown under different irrigation intervals in 2015 and 2016 growing season sat the farm of Agricultural Research Station, Sakha, Kafrelsheikh, Egypt. The Experiment was conducted using Randomized Complete Block Design with Strip-split plot arrangements. Main plots consisted of the three irrigation intervals namely; irrigation every 4 days (I1), irrigation every 8 days (I2) and irrigation every 12 days (I3), while sub plots devoted torice cultivars while the sub-sub plots contained the four levels of plant growth regulators: T1: spraying by cytokinein with concentration of 20 ppm, T2: spraying by abscisic acid with concentration of 15 ppm (ABA), T3: spraying by proline with concentration of 80ppm, T4: control (without any spray).The recorded data were chlorophyll content (SPAD), plant height (cm) at harvest, number of panicle (m-2), panicle weight (g), number of filled grains/panicle, number of unfilled grains/panicle, 1000- grain weight (g), grain yield (t/ha) and straw yield (t/ha). The main results indicated that irrigation every 4 and 8-days intervals cause an increase in all the previous studied characters, while irrigation every 12 days significantly reduced it. Spraying the tested rice cultivars by three growth regulators increased all studied characters as compared with control treatment. spraying Giza 179 cultivar with Cytokinin under the different irrigation intervals surpassed Giza177 cultivar and gave the highest value in all the studied characters expect 1000-grain weight followed by ABA. Spraying the two tested cultivars by Cytokinin under irrigation every 12 days which cause water stress relief the harmful of stress in the plant and increase the yield by about 3.2 t/ha specially with Giza179 cultivar as compared with control (without any growth regulator). Moreover, the application of cytokinein extend irrigation intervals from irrigation every 4 days up to irrigation every 8 days without any significant reduction in the yield. these results are benefit for farmers which safer from shortage of irrigation water in their rice field.

keywords: Rice (*Oryza sativa* L.), Cytokinin (CK), Abscisic acid (ABA), Proline, chlorophyll content, yield, irrigation stress.

INTRODUCTION

Rice (*Oryza* sativaL.) is one of the most important cereal crop in the world and it is the primary source of food and calories for about half of mankind Khush, (2005). In Egypt, Rice is one of the major water consuming crops and most of Egyptian rice genotypes are grown under continuous flooding with about 5 cm depth of standing water throughout the growing season. Most of Egyptian rice genotypes show better growth and higher productivity under continuous flooding conditions than ones exposed to water deficit at certain growth stages. Rice occupies about 22 % of the total growing area in Egypt during summer season and it consumed about 20% of the total water resources (Abd Allah, *et al*., 2009). Irrigation is an important practice in agriculture, the competition for fresh water in the development of urbanization, industry, leisure, and agriculture causes the decline of fresh water for irrigation Bergez and Nolleau (2003) and Zwart and Bastiaanssen (2004). Highest saving of irrigation water was found when irrigation intervals increased from continuous to irrigation every 12 days (El- Refaee, *et al*., 2012). Irrigation every 8 days produced high rice grain yield (9.77t/ha) for Giza179 which equal about 4.10 t/fed and save water about 23.66 % (El-Habet, 2014).

Plant growth regulators are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates thereby helping in effective flower formation, fruit and seed development and ultimately enhance productivity of the crops. Growth regulators can improve the physiological efficiency including photosynthetic ability and can enhance the effective partitioning of accumulates from source and sink in the field crops (Solamani *et al*., 2001).

Cytokinins (CKs) promote cell division and, acting both in synergy and antagonism with other plant hormones, influence a wide range of events during plant growth. The major portion of CKs is produced in meristematic regions in the root system and transported via xylem to the shoot. These CKs, along with the locally synthesized CKs, control development and senescence of the whole plant. CKs promote leaf expansion, accumulation of chlorophyll and conversion of etioplasts into chloroplasts, and delay leaf senescence. The molecular mechanism of CK action is only poorly understood and an information how endogenous CKs are affected under stress is meager (Pospíšilová *et al*.,2000).

Plant responses to CKs are often judged from their responses to exogenously applied CKs. However, when CKs was applied and follow the plant response, it is necessary to take into consideration that exogenous CKs (natural and synthetic) can increase content of endogenous CKs by their uptake and by promotion of CK biosynthesis. On the other hand, they can increase cytokinein oxidase activity and CK degradation (Hare *et al*. 1997, Kamínek *et al*. 1997). Thus, the composition and concentration of CKs in the site of action might be quite different than in the site of application.

The plant hormone abscisic acid (ABA) plays a major role in plant responses to stress. Although rapid production of ABA in response to drought and salt stresses is essential to define ABA as a stress hormone, an equally rapid catabolism of ABA when such stresses are relieved is also essential in that role. Among these regulated physiological responses, the plant hormone abscisic acid (ABA) plays a central role. ABA is defined as a stress hormone because of its rapid accumulation in response to stresses and its mediation of many stress responses that help plant survival over the stresses. How can this substance achieve this purpose? The first prerequisite is that its production should be sensitively and rapidly triggered by the stress to avoid any inhibition of plant growth and functions under unstressed conditions. The second prerequisite is that ABA should be rapidly degraded and deactivated once the stress is relieved such that normal plant growth and functions can resume. (Zhang., *et al*., 2006).

Proline has been proposed to act as compatible solute that adjusts the osmotic potential in the cytoplasm. Thus, proline can be used as a metabolic marker in relation to stress(Caballero, *et al*.,2005). Moreover, under water stress the accumulation of total soluble sugars in different plant parts would be increased (Hu, *et al*., 2006). However, the rate of additional production or accumulation of proline and soluble sugar is different in different plant parts. Although plant's leaf would monitor the osmolytes components more compared to the other plant parts, sheaths account for more contents rather than blades. Of-course, the sensitivity of leaves toward water stress depends on their ages and segments of plants (Rabas,A.R. and Martin, 2003. and Cabuslay, *et al*., 2002).

Application of CKs can reverse leaf and fruit abscission induced by ABA or water stress, or CKs release seed dormancy in contrasts with ABA inhibition of germination. The antagonism between CKs and ABA may be the result of metabolic interactions. CKs share, at least in part, a common biosynthetic origin with ABA (Cowan *et al*. 1999).

Various studies show that water stress negatively affects plants including rice and reduce yields in crops. Application of hormones and growth regulators on the other hand, improves growth parameters in the plants under drought stress. Therefore, the present study aimed to study the effects of spraying different plant growth regulator on some growth parameters, yield and yield components on two rice cultivars under differentlevels of irrigation intervals (water stress).

MATERIALS AND METHODS

Afield experiment was conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafrelsheikh, Egypt, during 2015 and repeated in 2016 rice growing seasons, to identify the impact of plant growth regulators i.e. Cytokinin (CK) with concentration of 20 ppm, Abscisic acid with concentration of 15 ppm (ABA), and proline (PL) with concentration of 80 ppm on growth yield and its attributes of both rice cultivars (Giza177 and Giza179) under different irrigation intervals i.e. irrigation every 4 days (I1), irrigation every 8 days (I2) and irrigation every 12 days (I3) (water stress). The field experiments were laid out in a strip-split design with four replications. The irrigation treatments were applied in the main plots, while the two rice cultivars were placed in the sub- plots and sub-sub plots comprised of plant growth regulating substances(PGRs)T1: sprayingby cytokinin, T2: spraying by abscisic acid (ABA), T3: spraying by proline, T4: control (without any spray).

Rice cultivars were sprayed with plant growth regulators twice after 15 and 30 DAT. Pre-germinated seeds of both rice cultivars at the rate of 120 Kg/ha, were broadcasted manually in the nursery on 10th of May in 2015 and 2016 seasons. Nitrogen (Urea 46 % N), Phosphorus single super phosphate 15 % at the rate of 36.89 kg P2O5/ha was added to the soil before tillage and Zinc (ZnSO4)was applied as recommended. Seedlings were manually pulled and transferred to the permanent field and transplanted in20 x 20 cm between rows and hills. The sub-sub plot size was 12 m2. The number of seedling/hill was 2-3 seedling. Seven days after transplanting, the herbicide Saturn 50% at the rate of 4.8 L ha-1 was mixed with enough amount of sand to make it easy for homogenous distribution to controlled the weeds. All the other agronomic practices were applied as the recommended of RRTC during the studied seasonin the permanent fields. Plant height (cm), chlorophyll content of flag leaf using (SPAD)chlorophyll meter Minolta camera Co. Ltd., Japan, number of panicles/m2, panicle weight (g), number of filled grains/panicle, number of unfilled grains/panicle, 1000- grain weight (g), grain and straw yields (t/ha)were estimated. Representative soil samples were taken from the experimental sites at (0-30 cm) depth from soil Surface. Physical and chemical analysis were done and the data were recorded in Table (1) Black *et al.* (1965).All the collected data were subjected to statistical analysis according to procedure described by Gomez and Gomez (1984). Means were compared at $p< 0.05$ by the revised least significant differences (LSD), which adapted by Waller and Duncan (1969).

Table 1. Soil physical and chemical properties of the experimental sites

Soil characteristics	Seasons	
	2015	2016
	Clayey	
Soil texture (%)	57.00	54.00
Clay %	11.00	11.00
Sand %	32.00	35.00
Silt %	8.05	8.2
pH (1: 2.5 water suspension)	2.0	2.05
EC (dSm-1)		
Organic matter	1.65	1.50
Available P mg Kg^{-1}	14.00	12.00
Available NH_4 mg Kg^{-1}	13.5	12.60
Available NO_3 mg Kg^{-1}	10.0	11.80
Available K mg Kg^{-1}	366	350
Cations (meq/L.)		
Ca^{++}	7.20	6.00
Mg^{++}	2.60	1.50
Na^{+}	12.00	13.00
K^{+}	0.50	0.50
Anions (meq/L.)		
$HCO3^{-}$	5.60	5.00
Cl-	14.00	14.00
$SO4^{--}$	2.70	2.00
$CO3^{--}$	0.00	0.00

RESULTS AND DISCUSSION

Chlorophyll content of flag leaf:

Chlorophyll content of flag leaf, plant height and number of panicles/m2 of Giza 177 and Giza179 rice cultivars as affected by different irrigation intervals, growth regulating substances and their interaction in 2015 and 2016 seasons are presented in table (2, 3, 4 and 5).

Data indicated that irrigation every 4 days produced the greatest chlorophyll content in the flag leaf followed by the irrigation every 8 days, while irrigation every 12 days gave the lowest value in this aspect. The decreases in chlorophyll content under the irrigation every 12 days could be attributed to water stress under this treatment which cause a decrease in chlorophyll biosciencesinside the plant celland increase the degradationin chlorophyll under the deficiency of water content. Also, the deficiency of water (water stress) inhibited the specific enzymes for biosynthesis of chlorophyll in chloroplast resulted in a decrease in the content of chlorophyll and cause senescence in rice leavesspecially flag leaf.

Data demonstrated that there were a significant differences between the two tested cultivars in chlorophyll content in the flag leaf in both studied seasons. Giza 177 cultivar gave the highest chlorophyll content in flag leaf as compared with Giza 179 cultivar in both studied seasons. It might be due to the difference in geneticconstitute. Data in the same table indicated that the foliar spray with plant growth regulators caused an increase in chlorophyll content of flag leaf. The highest values were observed when sprayed rice with both Cytokininand ABA, whilethe lowest value wasrecorded when sprayed the plants by proline or without growth regulators (control).

Table 2. Chlorophyll content of flag leaf, plant height (cm) and number of panicle/m^2 of Giza 177 and Giza179 rice cultivars as affected by different irrigation intervals and growth regulators during 2015 and 2016 season.

Treatments	Chlorophyll of flag leaf (SPAD)		Plant height (cm)		Number of panicle /m^2	
	2015	2016	2015	2016	2015	2016
Irrigation interval (A):						
Irrigation every 4 days (I_1)	39.666a	40.016a	90.93a	90.38a	513.93a	520.52a
Irrigation every 8 days (I_2)	38.999b	39.349b	86.93b	84.27b	488.74b	495.33b
Irrigation every 12 days(I_3)	36.519c	36.869c	84.27c	82.11c	400.73c	407.32c
F. Test	**	**	**	**	**	**
Rice varieties (B)						
Giza177 (V_1)	39.027a	39.377a	89.00a	86.79a	455.01b	461.60b
Giza 179 (V_2)	37.763b	38.112b	85.76b	84.39b	480.58a	487.17a
F. Test	**	**	**	**	**	**
Growth regulates Treatment (C)						
Spraying with Cytokinin(T_1)	39.112a	39.462a	89.74a	87.93a	496.95a	503.54a
Spraying with ABA(T_2)	38.872a	39.222a	87.83ab	85.59ab	472.12b	478.71b
Spraying with proline(T_3)	37.943b	38.293b	86.99ab	84.99ab	460.27c	466.86c
Control (T_4)	37.652b	38.002b	84.95b	83.84b	441.85d	448.44d
F. Test	**	**	*	*	**	**
Interaction:						
AXB	*	*	*	*	**	**
AXC	**	**	*	*	*	*
BXC	NS	NS	*	*	**	**
AXBXC	NS	NS	NS	NS	NS	NS

Data in Table (3) clarified that there were a significant differences between the two tested cultivars and the different irrigation intervals. Giza177 cultivar gave the highest chlorophyll content in flag leaf under irrigation every 4 days' intervals followed by 8 days' intervals without big difference between them, while Giza179 cultivar came in the second rank after Giza177cultivar under the same two irrigation intervals and had the same trend. On contrasted irrigation, every 12 days produced the lowest value in this aspect with the two studied cultivars specially Giza 179 cultivar in the two studied seasons. It could be attributed to the deficiency in the water (water stress) which cause a decrease in chlorophyll biosynthesis inside the plant cell (in chloroplast) and also might be due to the degradation of chlorophyll under water stress (irrigation every 12 days).

Regarding the interaction effect between irrigation intervals and growth regulators in chlorophyll content of flag leaf (Table 4), data showed that irrigated rice every 4-daysintervals recorded nearly the same value of chlorophyll content in flag leaf under different PGRs and control, while spraying Cytokinin or ABA under irrigation every 4 days gave the same value as irrigation every 8 days followed by proline as compared with control. On contrasted the lowest value was recorded by irrigation every 12 days because of the water deficit (water stress) which cause a reduction in biosciences of chlorophyll. Also, further, water stress usually accelerates leaf senescence. On contrast, Cytokinindelays leaf senescence due to the improve chlorophyll inside the plant cell. These findings are in close agreement with those reported by Soejima *et al*. 1992, Čatský *et al*. 1996, Naqvi 1999.

Table 3. Chlorophyll content of flag leaf, plant height (cm) and number of panicles /m^2 as affected by the interaction between different irrigation intervals and the two rice cultivars in 2015 and 2016 seasons.

Irrigation interval	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Chlorophyll content of flag leaf				
Irrigation every 4 days (I_1)	40.048a	39.285b	40.398a	39.635b
Irrigation every 8 days (I_2)	39.280b	38.718c	39.630b	39.067b
Irrigation every 12days(I_3)	37.753d	35.285e	38.103c	35.635d
Plant height (cm)				
Irrigationevery 4 days (I_1)	93.42a	88.45ab	92.40a	88.36ab
Irrigationevery 8 days (I_2)	88.42ab	85.45b	85.17ab	83.38b
Irrigationevery 12 days(I_3)	85.17b	83.38b	82.79b	81.43b
Number of panicles /m2				
Irrigationevery 4 days (I_1)	499.63b	528.23a	506.22b	534.82a
Irrigationevery 8 days (I_2)	476.28c	501.20a	482.87c	507.79b
Irrigationevery 12 days(I_3)	389.13e	412.33d	395.72e	418.92d

Table 4. Chlorophyll content of flag leaf, plant height (cm) and number of panicles /m^2 as affected by the interaction between different irrigation intervals and growth regulators in 2015 and 2016 seasons.

Irrigation interval	Plant growth regulators							
	2015 season				2016 season			
	Cytokinin	ABA	Proline	Control	Cytokinin	ABA	Proline	Control
Chlorophyll content of flag leaf								
Irrigationevery 4 days (I_1)	39.87a	39.66a	39.63a	39.50a	40.22a	40.02a	39.98a	39.85a
Irrigationevery 8 days (I_2)	39.86a	39.63a	38.50b	38.00bc	40.22a	39.98a	38.85b	38.35bc
Irrigationevery 12 days(I_3)	37.60cd	37.32d	35.70e	35.46e	37.95c	37.67c	36.05d	35.81d
Plant height (cm)								
Irrigationevery 4 days (I_1)	93.36a	91.67a	90.75ab	87.95abc	93.03a	90.56a	90.17ab	87.78abc
Irrigationevery 8 days (I_2)	89.36abc	87.67abc	86.75abc	83.95bc	86.50abc	84.17abc	83.47abc	82.95bc
Irrigationevery 12 days(I_3)	86.50abc	84.17bc	83.47c	82.95c	84.25abc	82.03bc	81.34c	80.81c
Number of panicles /m2								
Irrigationevery 4 days (I_1)	517.10a	515.00a	513.15a	510.45ab	523.69a	521.59a	519.74a	517.04ab
Irrigationevery 8 days (I_2)	514.15a	500.25b	480.30c	460.25d	520.74a	506.84b	486.89c	466.84d
Irrigationevery 12 days(I_3)	459.60d	401.10e	387.35f	354.85g	466.19d	407.69e	393.94f	361.44g

Plant height (cm): Plant height (cm) of two tested rice cultivars as affected by different of both water intervals, genotypes and different plant growth regulators and their interactions in 2015 and 2016 seasons are shown in Tables(2,3,4 and 5).

Data in Table 2 show that irrigation every 12 days (water stress)significantly decreased the plant height and reached to the minimizing value, while, the tallest plant was obtained from irrigation every 4 days. The reduction in plant height was occurred when rice imposed to water stress at active tillering. This is because of low leaf water potentials and reduction in photosynthetic activity which decline because of a decrease in stomatal opening and the inhibition of chloroplast activity when rice impose to water stress beside the reduce in the length of the internodes at process which follows tillering period. Giza 177cultivar came in the first rank flowed by Giza 179cultivar which came in the second rank in plant height (cm).

Also, Data showed that spray Cytokinin, ABA or proline gave nearly the same highest value of plant height in both seasons. Whereas, the lowest value was recorded in control (without PGRs) in the both seasons.

The interaction effect between irrigation intervals and rice cultivars are presented in Table (3). Data revealed that Giza 177cultivar and Giza 179cultivar gave nearly the same plant height and reached to the maximum valueunder treatment of irrigation every 4 days without significant difference with Giza177 cultivar under irrigation every 8-days intervals in the first and second season of study. Irrigation every 12-days intervals recorded the lowest plant height (cm) in the both seasons of study.

Data listed in Table 4 assured that there were highly significant differences in the interaction between irrigation intervals and PGR treatments in both seasons of study. Multiple range tests deemed that, spray rice with eitherCytokinin or ABA and proline improved plant height underirrigation every 4-days followed by irrigation every 8 days and 12-days. It might be due to the relief the injury of water stress specially under irrigation of 12-days. Whereas, the lowest value of plant height (cm) was recorded under the treatmentof irrigation every 12 days due to the application of PGRswithout spraying any of PGR (control) in both seasons.

From the results presented in Table 5, data showed that a significantinteraction between rice cultivars and PGR in plant height was observed. Giza177 cultivar surpassed Giza179 cultivar and gave the tallest plant when the two cultivar sprayed with the three tested PGR. While, the lowest plant highest was found when the two tested cultivars did not receive any of PGRs (control treatment). These results were hold true in the two studied seasons. Similar findings were reported by (Bahattacharjee, *et al.*, 1973 and De Datta, *et al.*, 1973).

Table 5. Plant height (cm) and number of panicles /m^2 as affected by the interaction between different growth regulators and two rice cultivars in 2015 and 2016 seasons.

Plant growth regulators	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Plant height (cm)				
Spraying with cytokinin.	91.92 a	87.56abc	89.89a	85.96abc
Sprayingwith ABA.	90.33ab	85.34bc	86.93ab	84.24bc
Sprayingwith proline	88.48abc	85.50bc	85.80abc	84.18bc
Control	85.26bc	84.63c	84.52c	83.17c
Number of panicles /m^2				
Sprayingwith cytokinin.	485.40b	508.50 a	491.99b	515.09a
Sprayingwith ABA.	457.27d	486.97b	463.86d	493.56b
Sprayingwith proline	448.70d	471.83c	455.29d	478.42c
Control	428.67e	455.03d	435.26e	461.62d

Number of panicles /m^2:

Table 2showthe number of panicles /m2of the two tested rice cultivars as affected by water intervals and different plant growth regulators during 2015 and 2016 seasons.

Data demonstrated that irrigation rice every 4 days recorded the highest number of panicles/m2 followed by irrigation every 8days while the irrigation every 12-days significantly reduced the number of panicles. It might be due to the decrease in number of tillers as result to water deficiency (water stress) under irrigation every 12-days beside the negative effect of water stress on the growth and initiation of panicles as a result to the reduction in phytochrome hormones that responsible for flowering. Also, Bahattacharjee. *et al.*, (1973), De Datta *et al.*, (1973) and Tantawi and Ghanem (2001) found that significant reductions in panicles numbers when rice imposed to water stress at tillering stage.

As for the difference between the two tested cultivars, data revealed that Giza 179 rice cultivar produced highe rnumber of panicles /m2 than Giza177 cultivarin the both seasons. It might be mainly due to the varietal differences according to genetic background.

From the result presented in Table (2)spraying Cytokinin gave the highest number of panicles /m2followed by ABA. Whereas, control gave the lowest value of number of panicles /m2 in both seasons. It can be easily noticed that the application of the three-plant growth regulating substance caused an increase in number of panicle as compared with control treatments.

The interaction between rice cultivars and different irrigation intervals had a significant influence on number of panicles /m2. From the results presented in Table 3, it could be concluded that Giza179cultivar produced the highest number of panicles /m2 under irrigation either every 4 days or every 8 days without any significant between them. While the lowest number of panicles were obtained with Giza177 cultivar when irrigated every 12 days.

Data in Table 4 show that rice plants which irrigated every 4 days and treated with different PGRs recorded the same values of number of panicles/m2 when rice plants irrigated every 8 days and treatedwithCytokininwithout any significant difference between them. It means that tested rice cultivars sprayed by Cytokinin led to extend the irrigation interval from 4-days up to every 8 days consequently save reasonable amount of irrigation water without significant reduction in the sink capacity (No. of panicles). While the lowest value of number of panicles/m2 were found with irrigation every 12 days under control treatment (without any spray). Such findings had also been pointed out by Bahattacharjee. *et al*., (1973) and De Datta *et al*., (1973).

Data in Table 5 show the interaction between rice cultivars and the tested plant growth regulator (PGR). Spray Giza 179 cultivar with Cytokinin gave the highest number of panicles /m2followed by ABA treatment. Whereas, the lowest value was recorded with Giza 177 cultivar under control treatment.

Panicle weight (g):

Panicle weight, number of filled grains/panicle and number of unfilled grains/panicle of the two tested rice cultivars as influenced by various irrigation intervals and different plant growth regulators, as well as their interactions in 2015 and 2016 seasons are listed in Tables (6,7,8 and 9).

Data in Table 6 indicated that the highest weight of panicle was obtained when rice irrigated every 4 days followed by irrigation every 8 days, while the lowest value was obtained with the irrigation every 12 days in both seasons of study. Similar results were reported by Rahman, *et al*., (2002), Bahattacharjee. *et al*., (1973) and De Datta *et al*., (1973).

Data in Table 6 show that Giza 179 cultivar gave the highest value of panicle weight (g) as compared with Giza177 cultivar in the first and second seasons. It might be due to the difference in the genetic constitution. The obtained results are in good agreement with those reported by Hany, *et al*., (2011), Metwally, *et al*., (2016) and Hashem, *et al*., (2016).

Data in the same Table revealed that Plant growth regulators caused an increase in panicle weight as compared with control. The highest panicle weight (g) was found when rice plants sprayed with Cytokinin followed by ABA which gave nearly the same in this aspect. Similar results were observed in the two seasons of study.

Table 6. Panicle weight/g, number of filled grains/panicle and number of unfilled grains /panicle of rice cultivars as affected by both different irrigation intervals and growth regulates during 2015 and 2016 season.

Treatments	Panicle weight/g		Number of filled grains/panicle		Number of unfilled grains /panicle	
	2015	2016	2015	2016	2015	2016
Irrigation every 4 days (I_1)	3.375a	3.526a	120.573a	122.814a	5.346b	6.996b
Irrigationevery 8 days (I_2)	3.017b	3.169b	109.568b	111.807b	6.266b	7.916b
Irrigationevery 12 days(I_3)	2.426c	2.579c	89.115c	91.355c	8.052a	9.703a
F. Test	**	**	**	**	**	**
Rice varieties (B)						
Giza177 (V_1)	2.738b	2.889b	100.334b	102.575b	5.305b	6.955b
Giza 179 (V_2)	3.141a	3.293a	112.503a	114.742a	7.805a	9.455a
F. Test	**	**	**	**	**	**
Growth regulates Treatment (C)						
Spraying with cytokinin.	3.247a	3.397a	114.433a	116.673a	5.575d	7.225c
Sprayingwith ABA.	3.033ab	3.185ab	108.437b	110.677b	6.323c	7.973b
Sprayingwith proline	2.849bc	3.006bc	103.817c	106.058c	6.765b	8.415b
Control	2.628c	2.778c	98.987d	101.227d	7.557a	9.207a
F. Test	*	*	*	*	**	**
Interaction:						
AXB	*	*	**	**	**	**
AXC	*	*	*	*	**	**
BXC	*	*	**	**	**	**
AXBXC	NS	NS	NS	NS	NS	NS

Data in Table 7 show that a significant interaction between irrigation intervals and rice cultivars in panicle weight wasobserved in both seasons of study. Data revealed that Giza 179 cultivar produced the highest panicle weight under irrigation every 4 days followed by irrigation every 8 days, while Giza177 cultivar came in the second rank after Giza179 cultivar. Whereas, the lowest value of panicle weight was observed with Giza 177 cultivarwhen irrigated every 12 days. It can be noticed that Giza 179 cultivar surpassed Giza177 under all the tested irrigation intervals and produced heavier weight of panicle. It means that Giza179 cultivar more tolerant to water shortage than Giza177 cultivar.

Regarding the interaction effect among irrigation treatments and plant growth regulators (PGR), data in Table 8 show that foliar application of any of plant growth regulators under either the irrigation every 4-daysor 8-days recorded the highest values of panicle weight except proline in the two studied seasons. It can be easily observed that there was any significant difference between the irrigation every 4-days and 8-days intervals in panicle weight when treated rice by Cytokinin or ABA. It might be due to the role of these substances to help the plant for keeping the water inside the cell more time consequently extend the period of irrigation intervals that led to save reasonable amount of irrigation water. These results are in good agreement with those reported by POSPÍŠILOVÁ, *et al*., (2000) and Soejima *et al*. 1992.

Data in Table 9 showed that a significant interaction between rice cultivars and PGR in panicle weight were recorded in both seasons of study. Data revealed that sprayed the tested cultivars by the growth regulating substance under study caused an increase in the weight of panicles as compared with control.Giza 179 cultivar surpassed Giza177 cultivar and gave the heaviest weight of panicle when sprayed by Cytokinin followed by ABA and proline in the two seasons of study. The same trend was found with Giza177 cultivar. From the previous data, it can be noticed that Giza 179 cultivar responded more to PGR than Giza 177 cultivar. The lowest value of panicle weight was recorded with Giza177 cultivar under control treatment (without PGR).

Table7. Panicle weight (g), number of filled grains/panicle and number of unfilled grains/panicles as affected by the interaction between different irrigation intervals and the two rice cultivars in 2015 and 2016 seasons.

Irrigation interval	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Panicle weight (g)				
Irrigation every 4 days (I$_1$)	3.158b	3.592a	3.307ab	3.745a
Irrigationevery 8 days (I$_2$)	2.868bc	3.165b	3.021bc	3.317ab
Irrigationevery 12 days(I$_3$)	2.188d	2.665c	2.340d	2.817c
Number of filled grains/panicle				
Irrigationevery 4 days (I$_1$)	110.130c	131.015a	112.372c	133.255a
Irrigationevery 8 days (I$_2$)	103.273d	115.863b	105.512d	118.102b
Irrigationevery 12 days(I$_3$)	87.600f	90.630e	89.840f	92.870e
Number of unfilled grains/panicle				
Irrigationevery 4 days (I$_1$)	4.405e	6.287c	6.055d	7.938bc
Irrigationevery 8 days (I$_2$)	5.525d	7.007b	7.175c	8.658b
Irrigationevery 12 days(I$_3$)	5.985cd	10.120a	7.635bc	11.770a

Table 8. Panicle weight (g), number of filled grains/panicle and number of unfilled grains/panicles as affected by the interaction between different irrigation intervals and growth regulators in 2015 and 2016 seasons.

Irrigation interval	Plant growth regulators							
	2015 season				2016 season			
	Cytokinin	ABA	Proline	Control	Cytokinin	ABA	Proline	Control
Panicle weight (g)								
Irrigation every 4 days (I$_1$)	3.505a	3.435ab	3.335a-c	3.225a-c	3.655a	3.585a	3.490ab	3.375ab
Irrigationevery 8 days (I$_2$)	3.400ab	3.235a-c	2.922b-d	2.510de	3.550ab	3.390ab	3.077a-c	2.660c-e
Irrigationevery 12 days(I$_3$)	2.835cd	2.430de	2.290e	2.150e	2.985b-d	2.580c-e	2.450de	2.300e
Number of filled grains/panicle								
Irrigationevery 4 days (I$_1$)	123.70a	120.55c	119.75d	118.29e	125.940a	122.790bc	121.995cd	120.530d
Irrigationevery 8 days (I$_2$)	122.28b	114.35f	104.69g	96.96h	124.520ab	116.585e	106.925f	99.200g
Irrigationevery 12 days(I$_3$)	97.32h	90.42i	87.02j	81.71k	99.560g	92.655h	89.255i	83.950j
Number of unfilled grains/panicle								
Irrigationevery 4 days (I$_1$)	5.430fg	5.365g	5.330g	5.260g	7.080e	7.015e	6.980e	6.910e
Irrigationevery 8 days (I$_2$)	5.360g	6.105ef	6.615de	6.985cd	7.010e	7.755de	8.265c-e	8.635cd
Irrigationevery 12 days(I$_3$)	5.935e-g	7.500c	8.350b	10.425a	7.585de	9.150bc	10.000b	12.075a

Number of filled grains /panicle:

Within irrigation intervals, data in Table 6 clarified that irrigation every 4 days produced the greatest number of filled grains/panicle followed by irrigation every 8 days while irrigation every 12 days gave the least because of the injury of water stress under this treatment. These results are in agreement with these detected by Rahman, *et al*., (2002), and Tantawi, and Ghanem, (2001).Data pronounced in Table 6 show that, highly significant differences between the two cultivars were found in filled grains/panicle in the two seasons. Giza179 cultivar gave higher number of filled grains/panicle than Giza 177 cultivar in the two seasons of study. The obtained data are in good agreement with those reported by Metwally, *et al*., (2016) and Hashem, *et al*., (2016)

Data presented in Table 6assert that there were a significant differences were found among the tested PGRs on number of filled grains/panicle in both seasons of study. Within various PGRs application, plants which spraying with Cytokinin gave the highest value of number of filled grains/panicle followed by spraying ABA which gave nearly the same value of number of filled grains/panicle through the two seasons under study.The lowest number of filled grains was obtained when rice did not receive any of PGR (control).These results are in coincidence with that reported by Morris, *et al*., (1993) and Saha *et al*., (1986).

The interaction effect between different irrigation intervals and rice cultivars had a significant effect on number of filled grains/panicle (Table 7). Data indicated that the highest number of filled grains were found when Giza179 cultivar was irrigated every 4 days followed by irrigation every 8 days, while the irrigation every 12 days significantly reduced the value in this respect in the two studied seasons.

Table 9. Panicle weight (g), number of filled grains/panicle and number of unfilled grains/panicle as affected by the interaction between different growth regulators and the two rice cultivars in 2015 and 2016 seasons.

Irrigation interval	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Panicle weight (g)				
Spraying with cytokinin.	3.000bc	3.493a	3.150ab	3.643a
Sprayingwith ABA.	2.747cd	3.320ab	2.897b	3.473a
Sprayingwith proline	2.704cd	2.993bc	2.861b	3.150ab
Control	2.500d	2.757cd	2.650b	2.907b
Number of filled grains/panicle				
Sprayingwith cytokinin.	106.110d	122.757a	108.350d	124.997a
Sprayingwith ABA.	102.453f	114.420b	104.693e	116.660b
Sprayingwith proline	98.173g	109.460c	100.417f	111.700c
Control	94.600h	103.373e	96.840g	105.613e
Number of unfilled grains/panicle				
Sprayingwith cytokinin.	4.490g	6.660d	6.140f	8.310cd
Sprayingwith ABA.	5.273f	7.373c	6.923ef	9.023bc
Sprayingwith proline	5.580ef	7.950b	7.230d-f	9.600b
Control	5.877e	9.237a	7.527de	10.887a

From the data presented in Table 8, application of Cytokinin under irrigation every 4-daysproduced the highest value of number of filled grains followed by irrigation every 8 days and surpassed both ABA and Proline which perform the same trend. It can be also, noticed that the application of any of PGR to the tested cultivars caused an increase in number of filled grains as compared with control. The promoting effect of PGRs under irrigation intervals on number of filled grain /panicle were reported by Salehi Gharaviran, *et al*., (2014), Xie, *et al*., (2004), Yang, *et al*., (2002) and Morris, *et al*., (2005)

The interaction effect between rice cultivars and PGRs had a significant influence on number of filled grains/panicle (Table 9). Data demonstrated that among all treatments, Giza 179 cultivar show superiority on number of filled grains/panicle when sprayed with Cytokinin followed by ABA as compared with giza177 cultivar under the PGR treatments. On the other hand, the lowest value of number of filled grains/panicle was recoded with control treatment.

Number of unfilled grains/panicle:

Data in Table 6 clearly assure that, irrigation every 12 days showed a marked superiority and gave the highest in number of unfilled grains/panicle followed by irrigation every 4 and 8 days which gave nearly the same value in this aspect in both studied seasons.

Significant differences were found between rice cultivars in terms of their number of unfilled grains/panicle in both studied seasons (Table 6).Data revealed clearly that Giza 179 cultivar produced the highest number of unfilled grains/panicle, while Giza177cultivar gave the lowest values of number of unfilled grains/panicle in both studied seasons. The results were supported by Hashem, *et al*., (2016), Rahman, *et al*., (2002), and Tantawi, and Ghanem, (2001).

There were a highly significant differences among all plant growth regulators innumber of unfilled grains/panicle in both seasons of study as presented in Table 6.Data revealed that, rice plants minimized their number of unfilled grains/panicle when sprayed by the different PGRs under study as compared with control which gave the highest number of unfilled grains/panicle. Spraying Cytokinin (CK)gave the lowest number of unfilled grains/panicle, while both ABA and proline gave higher value than cytokininin this respect.

Regarding to the interaction between rice cultivars and different irrigation intervals, data in Table 7 showed that Giza 179cultivar gave the highest number of unfilled grains/panicle under all the irrigation every 12-days treatment than Giza177 cultivar in the two studied seasons. The highest number of unfilled grains/panicle was obtained from Giza179 cultivar under the irrigation every 12 days followed by irrigation every 8 days, while the irrigation every 4 days gave the least. The same trend was observed with Giza177 cultivar under the same irrigate treatments.

The interaction between PGRs and irrigation intervals in number of unfilled grains/panicle is presented in Table (8). Data indicated that application of the tested PGRs minimized the number of unfilled grains under all the irrigation treatments as compared with control, while the lowest value was observed with Cytokinin under irrigation every 4 days. On the other side the highest value was found with control under irrigation every 12-days. The other treatments came in between. These results are conformity with those of Salehi Gharaviran, *et al*., (2014) and Jianchang Yang *et al*., (2000).

Regarding the interaction effect of rice cultivars and different plant growth regulators (Table9), it is obviously clear that spraying Cytokinin gave the lowest value of number of unfilled grains/panicle with Giza 177 cultivar, while the highest value of number of unfilled grains/panicle was recorded with Giza 179 cultivar under control treatment. It can be observed that the application PGRs reduced the number of unfilled grains as compared with control. Cytokinin decreased the unfilled grains followed by ABA and proline as compared with control.

Thousand grain weight/g:

Results presented in Table 10 conclude that the thousand-grain weight (g) had insignificant differences among the water intervals, the two rice cultivars and also, the different plant growth regulators under study. These results were hold true in the two studied seasons.

Table 10. Thousand grain weight/g, grain yield (t/ha) and straw yield (t/ha) of both rice cultivars as affected by different Irrigation intervals and different growth regulator during 2015 and 2016 seasons.

Treatments	Thousand grain weight/g		Grain yield (t/ha)		Straw yield (t/ha)	
	2015	2016	2015	2016	2015	2016
Irrigation interval (A):						
Irrigation every 4 days (I_1)	26.67	25.47	9.588a	10.099a	10.898a	11.778a
Irrigationevery 8 days (I_2)	27.08	25.84	8.782a	9.292a	10.025b	10.905b
Irrigationevery 12 days(I_3)	27.34	26.14	6.368b	6.878b	7.834c	8.714c
F. Test	NS	NS	**	**	**	**
Rice varieties (B)						
Giza177 (V_1)	27.71	26.48	7.852b	8.362b	9.056b	9.936b
Giza 179 (V_2)	26.35	25.15	8.640a	9.150a	10.115a	10.995a
F. Test	NS	NS	**	**	**	**
Growth regulates Treatment (C)						
Spraying with cytokinin.	26.13	24.89	9.067a	9.577a	10.361a	11.241a
Spraying with ABA.	26.82	25.62	8.581b	9.091b	9.926b	10.806b
Spraying with proline	27.33	6.13	7.874c	8.384c	9.372c	10.253c
Control	27.83	26.63	7.464d	7.974d	8.684d	9.564d
F. Test	NS	NS	**	**	**	**
Interaction:						
AXB	NS	NS	**	**	**	**
AXC	NS	NS	**	**	**	**
BXC	NS	NS	*	*	*	*
AXBXC	NS	NS	*	*	NS	NS

Grain yield (t/ha):

From the data presented in Table 10, it could be observed that irrigation every 4 days and 8 days intervals gave the greatest grain yield without any significant difference between them, while the irrigation every 12 days significantly reduced the grain yield in the two studied seasons. It means that irrigation every 8 days is quiteenough for producing the maximum grain yield. On the other side the reduction in grain yield under irrigation every 12 days could be attributed to the water stress which cause a decreases in both number of tillers and panicles, LAI, chlorophyll content, water and nutrient uptake as well as the shrinking in cell protoplasm, cell division and elongation consequently cause a reduction in the morphological and physiological process in the plant such as photosynthesis's and its assimilates resulted in a decrease in filling percentage and rates which produced low panicle and 1000-grain weight that cause a significant reduction in the grain yield.There was a linear relationship between available water and yield, where reduction in available water limits evapotranspiration and consequently reduced yield, as reported by several researchers Shani, and Dudley, (2001) and Sokoto and Muhammad (2014),Boonjung, and Fukai, (1996) reported that water stress at filling grains period with acceleration in ripening time, casing to a decreasing growth duration period and which led to a reduction in grain filling.

Data in the same Table show that Giza 179cultivar recorded the highest value of grain yield as compared with Giza 177 cultivar. It might be due to the differences in genetic constitution. The obtained data are in full agreement with those reported by Hany, *et al*., (2011), Metwally, *et al*., (2016) and Hashem, *et al*., (2016)

Data in Table 10 reveal the application Cytokininincreased grain yield followed by ABA, while proline reduced the grain yield and gave the same as control.

Regarding the interaction effect between water treatment and rice cultivars on grain yield, data presented in Table 11 indicated that Giza 179 cultivar gave the highest grain yield under irrigation every 4 days followed by irrigation every 8 days without any significant difference between them in the two studied seasons. The lowest grain yield was recorded by Giza 177 cultivar when irrigated every 12 days in both seasons.

Table 11. Grain yield (t/ha) and straw yield (t/ha) as affected by the interaction between different irrigation intervals and the two rice cultivars in 2015 and 2016 seasons.

Irrigation interval	Grain yield (t/ha)			
	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Irrigate every 4 days (I_1)				
Irrigate every 8 days (I_2)	8.990b	10.187a	9.500b	10.697a
Irrigate every 12	8.425c	9.140b	8.935c	9.650b
days(I_3)	6.142d	6.593d	6.652d	7.103d
	Straw yield (t/ha)			
Irrigate every 4 days (I_1)				
Irrigate every 8 days (I_2)	10.145c	11.651a	11.025c	12.530a
Irrigate every 12	9.203d	10.848b	10.083d	11.728b
days(I_3)	7.820e	7.848e	8.700e	8.728e

Data listed in Table 12 revealed that statistical differences were found in grain yield due to the interaction between different irrigation intervals and various plant growth regulators in the both seasons. Spraying Cytokinin gave the highest grain yield under irrigation every 4 and 8 days without any significant difference between them, while the lowest grain yield was recorded under irrigation every 12 days. As reported by previous studies, spraying of Cytokinin (CK) on the grains during the growth stage leads to increase in Cytokinin (CK)in these organs. Increased Cytokinin (CK)concentration in seeds during cell division caused increase in the number of endospermic cells which had positive correlation with the increase in grain yield Morris, *et al*., (2005). The same trend was observed with ABA specially in 2016 seasons. It can be observed that under irrigation every 4 days there were not any significant differences among all the tested PGRs and control because of there was not any water stress. It is important to observed that Cytokinin relief the harmful of water stress under irrigation every 12 days followed by ABA and proline as compared with control in the two studied seasons. Cytokinin is syntheses in rice roots and directly increase the root depth and volume and its viability as a result to free amino acid metabolism. The cytokinin translocate to the rice shoots and indirectly controlled protein metabolism and chlorophyll biosynthesis as well as the increases in cell division and elongation, also, the cytokinin inhibit the senescence of leaves and increase the viability of leaves especially flag leaf and both the second and third leaves which cause an increase in photosynthesis and its product (assimilates) resulted inincreased filling % that produce the heavier grains. Also, cytokinin concentration was high in the spikelets during filling period and cause an increase in cell division and elongation in the spikelets and then reached to the minimum concentration at the end of filling period.According to the findings of Kermode *et al.* (1989) and Yang *et al.* (2003)they found that the increase in ABA concentration at the beginning of period cell division decreased the significantly cell division. Also,ABA, contrary to CK, can reduce the grain filling period via stimulation of aging Nooden., (1988) resulting in grain yield loss. Finally, it can be assumed that ABA, contrary to Cytokinin (CK), a decreases the formation of endospermic cells of the seeds at first growth stage of seeds leading to decrease in grain yield due to source weakness in photosynthesis storage.

Proline is accumulated under a biotic stress and cause an increase in osmatic potential in plant cell to face the osmatic pressure outside the plant and also supply the plant with nitrogen.

Table 12. Grain yield (t/ha) and straw yield (t/ha) as affected by the interaction between different irrigation intervals and different growth regulatorsin 2015 and 2016 seasons.

Irrigation interval	Grain yield (t/ha)							
	Rice cultivars							
	2015 season				2016 season			
	Cytokine	ABA	Proline	Control	Cytokine	ABA	Proline	Control
Irrigate every 4 days (I_1)	9.689a	9.610ab	9.605ab	9.450ab	10.200a	10.120a	10.115a	9.960a
Irrigate every 8 days (I_2)	9.600ab	8.975bc	8.390cd	8.165d	10.110a	9.485ab	8.900bc	8.675c
Irrigate every 12 days(I_3)	7.910d	7.157e	5.628f	4.777g	8.420c	7.667d	6.138e	5.287f
	Straw yield (t/ha)							
Irrigate every 4 days (I_1)	11.090a	10.870a	10.835a	10.795a	11.970a	11.750a	11.717a	11.675a
Irrigate every 8 days (I_2)	10.845a	10.555a	9.925ab	8.775c	11.725a	11.435a	10.805ab	9.655bc
Irrigate every 12 days(I_3)	9.145bc	8.353cd	7.357de	6.482e	10.025bc	9.233cd	8.237de	7.362e

The interaction effect between PGRs and rice cultivars are presented in Table 13. Data revealed that Giza 179 cultivar treated by Cytokinin gave the highest grain yield whereas the lowest grain yield was recorded with Giza 177 cultivar under control treatment. Also, rice plant which treated by PGRs showed an increase in grain yield (t/ha) as compared with control.Singh and Sing (1980), reported varietal differences among the cultivar for moisture stress.

Table 13. Grain yield (t/ha) and straw yield (t/ha) as affected by the interaction between different growth regulators and two rice cultivars in 2015 and 2016 seasons.

Irrigation interval	Grain yield (t/ha)			
	Rice cultivars			
	2015 season		2016 season	
	Giza 177	Giza 179	Giza 177	Giza 179
Spray with cytokine.	8.657c	9.477a	9.167c	9.987a
Spray with ABA.	8.042de	9.119b	8.552de	9.629b
Spray with proline	7.506fg	8.243d	8.016fg	8.753d
Control (Tap water spray)	7.206g	7.722ef	7.716g	8.232ef
	Straw yield t/ha			
Spray with cytokine.	9.924b	10.796a	10.804b	11.676a
Spray with ABA.	9.260c	10.592a	10.140c	11.472a
Spray with proline	8.866d	9.879b	9.746d	10.759b
Control (Tap water spray)	8.173e	9.194c	9.053e	10.074c

The interaction effect among various irrigation intervals, the two rice cultivars and different plant growth regulators in grain yield are listed in Table 14. Data indicated a significant differences between the two cultivars in grain yield under both different irrigation intervals and plant growth regulators were observed. Moreover, the greatest grain yield was obtained from Giza179 cultivar when irrigated every 4 days under different PGRs and control while the same cultivar irrigated every 8 daysand treated with Cytokinin gave nearly the same grain yield as irrigated every 4 days. It might be due to role of cytokinin for relief the injury of shortage of water.Under water stress while ABA cause an increase in root depth and distribution which led to improve the uptake of both water and nutrients. Also, ABA increase cell division and elongation in both roots and shoots. On the other side, ABA minimizing the chlorophyll content and cause early senescence of leaves specially at heading. From the data in the same Table, it can be easily noticed that there was not any significant difference between the grain yield of Giza179 cultivar under the irrigation every 4-days and 8-days intervals when treated with cytokinin. It means that cytokinin cause extension of irrigation intervals from 4-days up to irrigation every 8 days without any significant reduction in the yield as well as saving reasonable amount of irrigation water.

Table 14.Grain yield (t/ha) as affected by the interaction between different irrigation intervals, two rice cultivars and different growth regulators in 2015 and 2016 seasons.

Irrigation interval	Variety	Grain yield (t/ha)			
		Rice cultivars 2015 season			
		Cytokinin	ABA	Proline	Control
Irrigation every 4 days (I_1)	Giza177(V_1)	9.070 bc	9.000b-d	8.990b-d	8.900b-e
	Giza179(V_2)	10.307a	10.220a	10.220a	10.000a
Irrigation every 8 days (I_2)	Giza177(V_1)	9.000b-d	8.500b-f	8.200c-f	8.000d-f
	Giza179(V_2)	10.200a	9.450ab	8.580b-f	8.330c-f
Irrigation every 12 days (I_3)	Giza177(V_1)	7.900f	6.627g	5.327hi	4.717i
	Giza179(V_2)	7.920ef	7.687f	5.930gh	4.837i
		2016 season			
Irrigation every 4 days (I_1)	Giza177(V_1)	9.580b-d	9.510b-d	9.500b-d	9.410b-d
	Giza179(V_2)	10.817a	10.730a	10.730a	10.510ab
Irrigation every 8 days (I_2)	Giza177(V_1)	9.510b-d	9.010c-e	8.710de	8.510de
	Giza179(V_2)	10.710a	9.960a-c	9.090c-e	8.840c-e
Irrigation every 12 days (I_3)	Giza177(V_1)	8.410de	7.137f	5.837gh	5.227h
	Giza179(V_2)	8.430de	8.197e	6.440fg	5.347h

Straw yield (t/ha):

Data in Table (10) indicated that rice plants grown under irrigation every 4 and 8 days statistically promoted their straw production and gave the highest straw yield compared with plants which were grown under irrigation every 12-days intervals. Lower straw yield could be as a result of water stress imposed at tillering which cause a decrease in photosynthesis, translocation rate and dry matter accumulation. Similarly tillersper unit area, plant height, number of leaves.

Data in the same table revealed that rice Giza 179cultivar showed superiority in their straw yield (ton/ha) compared to Giza 177rice cultivar in both seasons of study. These results could be mainly due to vigorous growth of Giza179rice cultivar in vegetative stage which has vigorous root system, big canopy, high leaf area index and thus dry matter production compared to Giza 177 cultivar by the other meaning it might be due to the genetic back ground.

Straw yield of rice as influenced by different plant growth regulators (PGRs) is presented in Table 10. Data indicated that spraying Cytokininmarkedly surpassed ABA and proline in straw yield and produced the greatest value followed by ABA and proline as compared with control in the two studied seasons.

Data in Table 11 show a highly significant interaction was recorded between different irrigation intervals and the two tested rice cultivars in straw yield in both studied seasons. Data indicated that Giza 179 cultivar recorded the highest value of straw yield under irrigation every 4 days followed by irrigation every 8 days in both seasons of study. On the other hand, the lowest value of straw yield was recorded with Giza 177cultivar under irrigation every 12 daysin the both seasons of study.

Straw yield as influenced by the interaction between different irrigation intervals and variousPGRs is present in Table 12.Data substantiated that there weren't any significant differences among all the PGRs and control under irrigation every 4 days in the both seasons. Application of Cytokininunder the irrigation every 4 and 8-days intervals gave the highest straw yield without any significant difference between them. On contrast the lowest values of straw yield were obtained when rice plant irrigated every 12 days with control. The current findings are similarity with those reported by Jianchang Yang *et al*., (2000); Morris, *et al*., (2005) and SalehiGharaviran, *et al*., (2014).

The interaction effect between PGRs and rice cultivars is presented in Table 13. Data revealed that Giza 179 cultivarsprayed with Cytokiningave the highest straw yield followed by ABA without any significant difference between them, whereas the lowest straw yield was recorded with Giza 177 cultivar under control treatment.

CONCLUSION

1- According to the previous results, it can be concluded that sprayed Giza179 rice cultivar by cytokinin prolonged the irrigation interval from 4 days up to 8 days that led to save reasonable amount of irrigation water.
2- Sprayed both Giza179 cultivar and Giza177 rice cultivar by the three-plant growth regulating substances relief the injury of water stress (irrigation every 12 days) as compared with control treatment. The most effective one was cytokinin which increase the yield by about 3.2 (t/ha) which equal 1.34 (t/fed) followed by ABA which increase the yield by about 1.9 (t/ha) which equal 0.8 (t/fed).
3- Giza179 rice cultivar more tolerant to water shortage than Giza177 rice cultivar and responded more to cytokinin application.

These results are very important for the farmers whose have shortage of water in rice fields.

Finally, this study needed to more study to reach the best results about using different growth regulators under different water stress.

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أثر بعض مواد منظمات النمو على المحصول ومكوناتة لصنفى الأرز جيزة 179 وجيزة 177 تحت فترات ري مختلفة.

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يعتبر نقص مياة الرى واحد من المشاكل الرئيسية التى تواجة زراعة الأرز ونقص إنتاجيتة من خلال تأثيرها على معدل النمو الخضرى وكمية المحصول ومكوناتة، لذلك إجريت تجربة زراعية لدراسة تأثير نمو صنفين من الأرز المصرى وهما جيزة 179 وجيزة177 وذلك نحت فترات ري ومنظمات نمو مختلفة وذلك خلال موسمى زراعة 2015 و2016، وذلك بالمرزعة البحثية بمحطة بحوث سخا– كفرالشيخ، وقد صممت التجربة فى قطاعات كاملة العشوائية المنشقة مرتين. تم وضع فترات الرى بالقطع الرئيسية وهى كالأتى: الرى كل 4 أيام (I_1)، والري كل 8 أيام (I_2) والري كل 12 يوم (I_3) وبالقطعة المنشقة الثانية الأصناف والقطع المنشقة الثالثة تم وضع مركبات الرش بتركيزتها المختلفة وهى : الرش بمركب السيتوكاينين بتركيز 20 جزء فى المليون (T_1)، والرش بمركب الأبسيسك أسيد بتركيز 15 جزء فى المليون (T_2)، الرش بمركب البرولين بتركيز 80 جزء فى المليون(T_3)، وعدم الرش لهذة المركبات (المقارنة) (T_4). تم أخذ البيانات الأتية وهى طول النبات عند الحصاد (سم)، ومحتوى الكلورفيل، عدد السنابل/م2، وزن السنبلة/جرام، عدد الحبوب الممتلئة والفارغة /سنبلة ، وزن الألف حبة (جرام)، محصول الحبوب والقش (طن /هكتار). وقد اظهرت النتائج ان الصنف جيزه 179 اكثر تحملاً لطولفترات الري من الصنف جيزه 177 خصوصاً مع الرش بالسيتوكاينين حيث أعطى الصنف أعلى محصول له مع الرى كل 8 أيام . كان للرشبالسيتوكاينين ويليه الأبسيسك تأثير واضحاً على صفات النمو فى كلا الصنفين حيث سبب زيادة فى كل صفات النمو الخضرى سابقة الذكر مقارنة بالكنترول (المعاملة التى لم يتم رشها بأى من هذه المركبات) ونفس التأثير ظهر أيضاً على كل مكونات المحصول السابقة الذكر ماعدا وزن الالف حبة. كما أظهرت النتائج ان هذه المركبات كان لها أثر كبير فى تخفيف الضرر الناتج عن نقص الماء فى معاملة الرى كل12 يوم وخصوصاً الرش بالسيتوكاينين الذى سبب زيادة فى المحصول حوالى 3.2 طن/للهكتار مقارنة بالكنترول (بدون رش). وهذه النتائج لها اهمية كبرى عند المزارعين الذين يعانون من نقص الماء فى حقول الأرز- مثل المزارعين التى توجد أراضيهم فى نهايات الترع، بإستخدامهم لهذه النتائج تفيدهم كثيراً فى زيادة محصول الأرز تحت هذة الظروف.