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EFFECT OF PLANTING AND WATER TERMINATION DATES ON PRODUCTIVITY AND GRAIN QUALITY OF GIZA 179 RICE CULTIVAR

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ABSTRACT: *Planting dates and irrigation regimes are important aspects of successful rice production. In order to determine the effects of different planting and irrigation termination dates on productivity and some grain quality of Giza 179 rice cultivar, two sets of field experiments were initiated during 2016 and 2017 seasons at the Experimental Farm of Sakha Research Station, Kafr El-Sheikh, Egypt. Each experiment was laid out in a randomized complete block design (RCB), with four replications. In experiment (1), five planting dates were used (20th April, 1st May, 10th May, 20th May and 1st June). However, in experiment (2), six dates for terminating irrigation were used (terminating irrigation after complete heading, 5, 10, 15, 20 and 25 days after complete heading). The results of experiment (1) showed that early in planting date (20th April) took the longest duration to attain 50% heading, however, there was a decreasing in plant height when planting was delayed beyond 10th of May. Early (20th April) and mid (1st and 10th May) planting gave the highest values of number of panicles, panicle length, number of grains/panicle, panicle weight,1000 grain weight, grain and straw yields. However, late planting (20th May and 1st June) significantly reduced all previous traits, but gave the highest unfilled grains percentage. Grain length and shape as well as milling and head rice percentage gradually increased with delaying of planting date. Also, planting dates had significant effects on amylose content, but there was insignificant effect on gel consistency and gelatinization temperature. The results of experiment (2) indicated that plant height, number of panicles/m^{2}and panicle length were not significantly influenced by dates of irrigation terminates. The grain yield and its attributes (number of grains/panicle, panicle grain weight and 1000- grain weight) were significantly increased with delay withholding irrigation compared with earlier cut-off dates of irrigation, which recorded the highest unfilled grains percentage. There were no significant differences among the last three treatments, in first season and between the last two treatments, in second season for grain yield. Withholding irrigation immediately at complete heading recorded the minimum values of grain length, width, milling recovery (hulling, milling and head rice %) and amylose content as compared with the other irrigation terminates .*

Finally, it could be concluded that, , a planting date of 1st and 10th May might enable to achieve high grain yield for Giza 179 rice cultivar . However, delayed planting up to 20th May achieve acceptable grain quality. Also, maximum grain yield and acceptable technological characters seem to be associated with delay in withholding of irrigation up to 20 days after complete heading.

Key words: *Rice, planting date, irrigation termination, grain yield, grain quality.*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the world's most important staple food crops, it is main diet of 3.5 billion people Liu *et al.,* (2011). By the year 2025, it is necessary to produce about 70 % more rice, than what is current production to meet the food needs of a growing world population Swaminathan (2007). Rice, following wheat, is the major staple for the large and growing population of the Egyptian. It occupies about 600 thousand hectares which represent about

22% of the cultivated area during summer season. Rice production must increase by about 20% to maintain current levels of consumption. Therefore, improvement in its yield while maintaining high quality is a long term goal in Egypt. Grain quality is not just depends on the variety of rice, but quality also depends on the crop production environment, harvesting, processing and milling systems. Times of planting and irrigation terminating dates are the important factors influencing grain yield of the crop. Although rice is consumed worldwide, therefore is no universal rice quality attribute Veronic *et al.,* (2007). Nevertheless, rice appearance and cooked rice texture are the characters considered as main quality attributes by consumers Rousset *et al.,*(1999). Thus, measuring and understanding factors that influence appearance and texture properties are a great challenge for industries and breeders in meeting consumer preferences Haider *et al.,* (2015).

Excessive heat during the pollination period and grain filling stage caused disorder in grain formation and grain weight which reduced the grain yield. So, correct planting time is crucial to achieve high yields and the best grain quality for rice. Therefore, optimum rice planting dates are regional and vary with location and genotypes Bashir *et al.,* (2010). Selecting appropriate planting date is an important factor in the efficient management of crop adaptation to physiological processes and morphological. Planting rice after the optimum dates can result in higher disease and insect incidence, tropical storm-related lodging, and possible weather damage during heading and the grain filling period resulting in low yields Groth and Lee (2003). However, Slaton (2001) reported that planting earlier than the optimal date leads to lengthening of the time interval between cropping and grain maturity, longer pesticide and weeds control periods, more water consumption, biological yield enhancement and reduction in grain yield. On the contrary, most of the panicles become immature in delayed planting resulted in low grain yield.

Rice grain filling and ripening are affected by many environmental factors, including water, temperature, radiation, and soil nutritional conditions Yoshida (1981). So, scheduling last irrigation (terminating irrigation) at the correct stage of maturity may influence moisture content in grain at harvest and, then, affect on grain yield and quality. Whereas, cut-off irrigation on rice fields early may cause moisture stress in grains before they are physiologically mature, this may lead to lower harvest moisture contents associated with lower head rice yield. This practice causes a significant reduction in grain yield and increasing the unfilled, immature and broken, grains. However, delayed cut-off irrigation up to 3- and 4-weeks after complete heading significantly increased grain yield and most of its attributes, as well as grain quality Omar *et al.,* (2012). El-Refaee (2007) reported that withholding of irrigation 21 days after heading is considered as the optimum timing of last irrigation to rice field to get high grain yield and quality.

Herein, the present study aimed to find out the optimum timing for planting and irrigation termination for higher grain yield and acceptable grain quality characteristics of Giza 179 rice cultivar.

MATERIALS AND METHODS

Two sets of field experiments were conducted, during 2016 and 2017 seasons, at the Experimental Farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt. The aim of these studies was to determine the effects of different planting dates (Experiment 1) and time for irrigation termination (Experiment 2) on productivity and grain quality of Giza 179 rice cultivar. Each experiment was laid out in a randomized complete block design (RCB), with four replications. Experiment (1) was conducted in different five successive planting dates by the difference of 10-days interval between each other viz.: (20th April, 1st May, 10th May, 20th May and 1st June). However, in experiment (2), six dates of irrigation terminating (terminating irrigation after complete heading (ACH), 0, 5, 10, 15, 20 and 25 days after complete heading (DACH)were used. The meteorological data, according to Sakha Meteorological Station, of the experiment sites are showed in Table (1).

All experiments were preceded by flax (*Linum usitatissimum*) in both seasons. The soil was clay with pH 8.2 and 8.0 and an organic matter content of 1.8 and 1.6 %. The total N was 520 and 500 ppm in both seasons, respectively. The experiment (1) was sown according to the planting date treatment, however, the experiment (2) was sown on 1st and 4th of May in the two successive seasons. In both sets of field experiments, seeds of Giza 179 rice cultivar, at a rate of 96 kg/ha, were soaked in sufficient water for 24 hours and incubated for another 48 hours to enhance germination. Pre-germinated seeds were broadcasted, in the presence of water, after puddling the nursery. Three to four seedlings, 30 days old, were transplanted at 20 x 20 cm distance among hills and rows, in plot size of 30 m^2 (5 x 6 m) each. Phosphorus (35.5 kg P_2O_5/ha), potassium (57 kg K_2O/ha), nitrogen (165 kg N/ha, in the form of Urea 46 % N) and zinc (24 kg Zn SO_4/ha), as well as all other routine cultural practices were done, according to the recommendations to grow a successful rice crop. To avoid lateral movement and more water control, each main plot was separated by two meter wide ditches.

At harvest, plant height was randomly measured from ten hills for each unit plot, with the help of a meter scale from the base of the plant to the tip of the panicle. Number of panicles were recorded through counting the number from the randomly selected ten hills from each plot then, converted into numbers/m^2. Total number of grains/panicle, unfilled grains percentage and panicle length were counted from ten randomly selected panicles from each plot. The weight of 1000 grains was measured from taking random samples of each unit plot. The straw and grain yields were randomly measured from an area of 9 m^2 (3 x 3 m) in each plot and grain yield adjusted to 14 % moisture content and, then, converted into t/ha. Quality of rice grains are defined by the physical appearance, cooking and eating qualities. Grain characteristics of rice grain were determined at the grain quality laboratories of the RRTC as follows: physical appearance (Grain length, width and shape (L/W ratio)) and milling recovery (hulling, milling and head rice %) were measured, according to the method described by Juliano (1971), Khush *et al.,* (1979) and IRRI (1996). Amylose is one of the starches, and in rice, the amount of amylose ranges from 0% to 30%. Commonly, the Egyptian rices are low amylose, ranging from about 17–20%. Amylose content was determined byauto-analyzer based on the iodine-colorimetric method Juliano (1971). Gel consistency measures the tendency of the cooked rice to harden on cooling. It was determined according to the test of Cagampang *et al.,* (1973). Gelatinization temperature is the temperature at which the starch in rice begins the process of cooking. At this point the starch granules take in water and lose their crystalline nature, a change that is irreversible. Temperature of gelatinization process was distinguished Little *et al.,* (1958).

The analysis of variance was carried out according to Gomez and Gomez (1984) using GENSTAT 5thEdition Computer Program. Means were compared, using the least significant differences (LSD) at 5% probability level.

Table (1): Monthly temperature means, relative humidity (RH) and pan evaporation (E) at the experimental site during growth period.

Month	2016					2017				
	Air temperature (^0C)		RH %		E (mm/ day)	Air temperature (^0C)		RH %		E (mm/ day)
	Max.	Mini.	7:30	13:30		Max.	Mini.	7:30	13:30	
April	30.3	18.62	81.6	41.8	5.94	26.5	21.6	79.4	50.8	4.64
May	30.4	22.8	71.0	45.8	6.47	30.6	25.8	77.7	45.6	6.59
June	33.6	26.3	75.7	46.6	8.07	32.5	28.1	80.1	51.4	7.10
July	33.7	26.1	82.7	65.8	7.84	34.2	29.0	84.4	57.6	6.44
August	33.6	26.0	84.3	56.3	7.74	33.9	28.3	85.9	55.3	6.04
September	32.6	24.3	83.1	51.8	5.91	32.5	25.9	86.3	50.3	5.37

RESULTS AND DISCUSSION

Experiment (1): Effect of different dates of planting.

I-Days to 50 % heading, plant height, grain yield and its attributes:

The results in Table 2 show that the number of days to 50% heading, plant height, grain yield and its attributes were significantly affected by the planting dates. Days to 50% heading, which is an indicator of maturity time, was significantly decreased in case of delayed planting. Early planting date of 20thApril spent the longest duration to attain 50% heading, however, late planting date in 1stJune had the least days to attain 50% heading. Heo *et al.,* (2017) reported that the whole growth period of rice was shortened with the delay of sowing date. There was a decreasing trend in plant height, particularly when planting was delayed beyond May10th . The sowing dates 20th April, 1st May and 10th May produced the maximum plant height, Table 2. The lowest plant height was produced from the last sowing date (1st June). Sowing dates from 20th April to 10th May produced statistically similar and tallest plant heights, while late sowing (20th May and 1st June) they produced statistically different plant heights. Rai and Kushwaha (2008) observed that the delay in planting decreased plant height (13%), number of days to 50% flowering (12 to 15 days). Safdar *et al.,* (2013) found that days to 100% flowering were found having decreasing trend in all accessions due to delayed sowing. Also, plant height seems to be downward as their sowing times were delayed.

The grain yield attributes are the most important parameters of any crop which directly influence the crop yield. Late in planting caused a remarkable reduction in most of grain yield attributes, Table 2. In both seasons, early planting date (20thApril) and medium planting dates (1st and 10th of May) gave the highest values of number of panicles, panicle length, no. of grains/panicle, panicle weight and 1000 grain weight. However, late in planting (20th May and 1st June) significantly reduced all previous traits, but gave the highest unfilled grains percentage. Improvement in these parameters can be better explained by the fact that the crop planted from 20th April to 10th May received optimum environmental conditions required for better growth and development. Abou-Khalifa (2009) indicated that early date of sowing is the best time for important properties such as number of grains panicle^{-1}, panicle length, 1000-grain weight, number of panicles m^{-2}, panicle weight and grain yield.

Table (2): Days to 50 % heading, plant height, grain yield and its attributes of Giza 179 rice cultivar as affected by planting dates in 2016 and 2017 seasons.

Season	Character	Planting date					LSD 5%
		21 Aril	1 May	10 May	20 May	1 June	
2016	Days to 50 % heading	96.25	94.75	94.25	93.00	92.50	1.51
	Plant height (cm)	90.25	89.50	88.50	83.75	81.00	3.28
	No. of panicles/m^2	489.8	488.8	478.8	427.5	381.3	46.5
	Panicle length (cm)	20.10	19.80	19.48	18.85	18.42	1.05
	No. of grains/panicle	125.6	122.8	120.1	102.0	80.9	4.6
	Unfilled grain (%)	4.43	4.76	5.22	6.81	8.39	0.94
	Panicle weight (g)	2.96	2.84	2.64	2.25	2.02	0.42
	1000-grain weight (g)	24.82	25.77	25.60	24.66	23.50	1.28
	Grain yield (t/ha)	11.79	12.58	12.68	10.58	9.55	0.87
	Straw yield (t/ha)	15.18	14.75	14.58	12.70	10.88	1.10
2017	Days to 50 % heading	98.50	97.50	97.00	94.75	92.50	1.16
	Plant height (cm)	91.95	91.45	89.85	84.60	78.60	2.47
	No. of panicles/m^2	463.8	462.5	451.3	411.3	324.4	50.7
	Panicle length (cm)	18.85	19.43	19.30	18.63	16.70	0.92
	No. of grains/panicle	116.2	114.0	112.5	104.7	80.3	10.6
	Unfilled grain (%)	5.58	5.85	6.28	6.95	6.78	1.02
	Panicle weight (g)	2.86	2.96	2.61	2.22	1.99	0.33
	1000-grain weight (g)	25.62	25.30	25.42	25.05	23.80	0.96
	Grain yield (t/ha)	11.75	12.04	12.10	10.81	9.38	0.80
	Straw yield (t/ha)	14.05	13.60	13.80	12.90	11.45	0.97

NS = Not significant

These results, also, indicated that exposing rice plant to late planting caused significant reduction in grain and straw yields, this held true since all yield attributes were affected by such conditions. There isn't any significant difference among the three dates of planting (21st April, 1st May and 10th May) in the two seasons of study. Grain yield increased with delay of sowing date until reached the peak grain yield values which achieved at 10th May. The third sowing of rice (10th May) gave the maximum grain yield (12.68 and 12.10 t/ha), followed by 1st May sowing (12.58 and 12.04 t/ha) and then early sowing date of 20th April (11.79 and 11.75 t/ha). The significant lowest grain yield (9.55 and 9.38 t/ha) were noted from 1st June sowing, in the two successive seasons. Results showed that in first, second and third planting dates because of appropriate growth condition and reaching to maximum use of environmental condition, most grain yield was produced. It is the fact that the unavailability of weather condition inhibits the production of dry matter content in the different plant organs beside number of panicles/m^2, number of filled grains/panicle and grain yield. The grain yield reductions might be due to reduction in vegetative growth period on account of delayed sowing. Alizadeh and Osivand (2006), announced a delay in sowing rice, shorten vegetative phase and reducing the accumulation of carbohydrates and minerals in different organs and subsequent spike length and grain yield decreased. The yield reductions under later sowing dates have been reported by Singh *et al.,* (2012), Tiwari (2015) and Osman *et al.,* (2015).

The sowing dates exerted significant influence upon straw yield. Accordingly, among the sowing dates, earliest 20thApril sowing recorded maximum straw yield (15.18 and 14.05 t/ha), closely followed by 1st May and 10th May sowing. The significant lowest straw yield (10.88 and 11.45 t/ha) were recorded from late sowing date 1st June in both seasons, respectively. Similar finding were reported by Rai and Kushwaha (2008) and Tiwari (2015).

II- Grain quality:

Rice quality is a combination of physical and chemical characteristics which are required for a specific use by a specific user.

A- Physical appearance characters.

Most of the farmers and consumers depend mainly on visual characters for differentiation and evaluation of rice varieties. Grain length is measured from the base to the top of the milled grains. The length and width of a rice grain are important attributes that determine the class of the rice. The ratio of the length and width is used internationally to describe the shape and class of the variety. Milled rice is classified on the basis of average length into four classes: short, medium, long, and extra long. Grain length was significantly affected by different planting date (Table 3). Grain length increased with delayed planting date upto 20th May and thereafter, declined. The longest grain (5.78 and 5.66 mm) was observed when rice plants were planted in 20th May and the shortest grain (5.27 and 5.21 mm) from early planting in 20thApril, in the two respective seasons. In both seasons, grain width was not influenced up to significant extent due to different dates of planting. However, grain shape was significantly responded to different planting date only in first season Table 3. The highest value was recorded when plants were planted in 20th May as compared with other planting dates, however, the lowest value was obtained in planting date of 1st May.

B- Milling recovery characters.

Data regarding hulling, milling and head rice percentage had significant differences due to different planting dates, Table 3. Generally results showed increasing trends for hulling percentage with delayed planting reaching the maximum value (79.41 and 77.33 %) at third date (10th May) thereafter declined to give the minimum value (76.75 and 75.95 %) with delayed planting up to 1st June, in the two respective seasons. The data, also, showed that milling percentage gradually increased with the delaying of planting date. In both seasons, the lowest percent of milling (66.15and 65.11 %) was given by the early sowing date at April 20th. On the other hand, the late planting date at June 1stwas resulted in obtaining high percent of milling (70.47 and 70.22 %).

Head rice percentage gradually increased with delaying planting, where, the maximum value was obtained with planting dates at 10th May (62.92 %), in first season, and with planting date at 20th May (63.44%), in second season. However, the lowest percentage was observed for the sowing date 1st June in both seasons. The head rice reductions might be due to higher temperature and unavailability of weather condition, during grain filling, recorded in delay planting resulted in low head rice recovery and higher broken rice. Both delayed and early planting dates resulted in the decline of milling quality of rice. The reason for these reductions was the shortening of the vegetative growth period in the case of delayed planting, and the coincidence of the flowering stage with environmental high temperatures in earlier planting dates compared to the desirable state. Jia- gou *et al.,* (2003) found that the grain quality interrelated to the grain filling degree. It was better to keep water in paddy until 25 days after 80% of full heading for rice quality cultivation.

Table (3): Physical, milling, cooking and eating quality characters of Giza 179 rice cultivar as affected by planting dates in 2016 and 2017 seasons.

Season	Character	Planting date					LSD 5%
		20 Aril	1 May	10 May	20 May	1 June	
2016	Physical characteristics						
	Grain length (mm)	5.21	5.27	5.46	5.78	5.59	0.17
	Grain width (mm)	2.53	2.63	2.72	2.59	2.60	NS
	Grain shape	2.07	2.00	2.01	2.23	2.15	0.19
	Milling quality						
	Hulling (%)	78.19	79.00	79.41	76.65	76.75	1.34
	Milling (%)	66.15	66.30	67.00	68.59	70.47	2.55
	Head rice (%)	57.77	60.00	62.92	59.92	57.42	2.59
	Cooking and eating quality						
	Amylose content	18.27	18.46	17.49	17.16	17.15	1.03
	Gel consistency	87.65	87.49	87.78	87.16	87.26	NS
	Gelatinization temperature	6.00	6.50	6.50	5.75	5.75	NS
2017	Physical characteristics						
	Grain length (mm)	5.27	5.28	5.44	5.66	5.45	0.15
	Grain width (mm)	2.57	2.60	2.66	2.61	2.60	NS
	Grain shape	2.05	2.03	2.04	2.16	2.10	NS
	Milling quality						
	Hulling (%)	76.93	77.11	77.33	76.44	75.97	1.49
	Milling (%)	65.11	66.67	66.22	68.00	70.22	1.57
	Head rice (%)	59.37	59.89	62.63	63.44	57.88	3.20
	Cooking and eating quality						
	Amylose content	18.65	18.34	18.06	17.97	17.78	0.56
	Gel consistency (mm)	88.07	87.70	87.42	87.31	87.31	NS
	Gelatinization temperature	6.25	6.50	6.25	6.00	6.00	NS

NS = Not significant

C- Cooking and eating quality characters.

Amylose content is a major determinant of cooking and eating quality characters of rice. It is considered to be the key factor that contributes to the cooking quality of rice grains. Planting dates had significant effects on amylose content, but there was no effect on gel consistency and gelatinization temperature, in both seasons, Table 3. The temperature during grain ripening has been showed a remarkable effect on the amylose content. Generally, it decreased as the mean temperature increased, depending on the variety and inherent level of amylose content. Amylose content decreased slightly with delayed planting date, although that, it is still in low amylose content.

Generally, environmental factors like temperature, photoperiod and relative humidity have been documented to have little effect on the width of grains, gel consistency and gelatinization temperature compared with that on grain length, grain shape, milling recovery and amylose content. Singh *et al.,* (1995) reported that late sowing date gave maximum hulling and head rice percentage while, it decreased the milling % and amylose content. Delaying sowing date decreased the percentage of milling, head rice and amylose content. Xing *et al.,* (2016) found that the appearance quality was ameliorated when the sowing date was postponed. Also, the postponement of sowing date reduced the amylase content and shortened the gel consistency. These current results were in agreement with the findings of Heo *et al.,* (2017).

Experiment (2): Effect of different dates of irrigation termination:

I- Plant height, grain yield and its attributes:

plant height, number of panicles/m^2 and panicle length were not significantly influenced by the dates of irrigation termination studies, due to compete its growth by the time of last irrigation and suspended at complete heading, Table 4. The grain yield and its attributes (number of grains/panicle, panicle grain weight and 1000-grain weight) were significantly increased with delay in withholding of irrigation compared with earlier cut-off dates of irrigation in both seasons except straw yield in first season. On the other hand, unfilled grains percentage was decreased. The grain yield was found to be maximum under termination of irrigation at 20DACH (11.98 and 11.89 t/ha) followed by withholding of irrigation at 25 DACH (11.77 and 11.34 t/ha) and then 15 DACH, without significant differences among the last three treatments in first season and between the last two treatments in second season. The comparatively lower grain under early withholding irrigation might be significantly attributed to lesser panicle length, grains per panicle and numerically less panicles/m^2 resulted from shorter supply of moisture at ripening stage than 20 and 25 DACH. Also, the increase in grain yield attributes, with delayed irrigation termination, was the reason for the increase grain yield in 20DACH treatment. The results, also, indicates that under early termination of irrigation, the carbohydrates stored in the lower vegetative parts get less translocated to grains, when the concurrent insufficient for photosynthates-sink in the grain owing to plant-water deficit and then, decreased the grain yields.

However, continuing irrigation up to 20 DACH might have improved the translocation of the current photosynthates and resulted in higher grain filling process thereby, increased grain yield. The results are in conformity with the findings of Uppal and Bali (1994), El-Refaee (2007), Brar *et al.,* (2009) and Omar *et al.,* (2012).

II- Grain quality:

Grain quality of rice refers to many characters such as physical appearance, milling recovery, cooking and eating quality. Those characters are considered as the most important traits that affected rice quality and consumer demand.

A- Physical appearance characters:

Length and width of rough grains were responded significantly due to cut-off irrigation treatments. Where the ceiling length and width produced at 15 and 20 DACH without any significant differences between each other in both seasons of study. Whereas, the grain shape was statistically the same with different dates of withholding irrigation in both seasons, Table 5. Cut-off irrigation early at complete heading recorded the minimum values of grain length and width as compared with the other irrigation termination in two seasons. The results are in agreement with those obtained by El-Refaee (2007).

B- Milling recovery characters:

Results in Table 5 indicated that cut off water irrigation at 20 DACH significantly increased hulling, milling and head rice recovery of rice grains than early withholding irrigation at complete heading. The milling recovery with delay irrigation withholding beyond 15 DACH was high due to the corresponding increase in the moisture content of the grain. However, lower milling recovery in the treatment receiving last irrigation immediately at complete heading and 5 DACH might be due to early drying of the grains before completion of ripening. The results are in conformity with the findings of Uppal and Bali (1994), El-Refaee (2007) and Omar *et al.,* (2012).

Delaying last irrigation up to 20 and 25 DACH resulted in higher head rice recovery, however, in early irrigation withholding at heading the moisture content in grain was low and broken rice recovery was high. Besides, delaying harvesting (for the first three treatments) along with other alternative treatments may resulting low moisture content in grain during day and in night some amount of moisture is re-absorbed by the deposition of dew. Such circumstances as alternate drying and wetting cycles cause mechanical stress which may resulted in the development of fissures and ultimately in higher percentage of broken rice. The less head rice recovery under early withholding irrigation might be ascribed to incomplete grain filling due to impairment of current photosynthesis and translocation of assimilates towards sink. This may have increased number of chalky grains, which got broken during processing. Bali (1992) also recovered significantly less head rice from scented rice under early suspension of irrigation at 7 and 14 days after 50% flowering than delayed at 21 days after 50% flowering.

Table (4): Days to 50 % heading, plant height, grain yield and its attributes of Giza 179 rice cultivar as affected by irrigation termination dates in 2016 and 2017 seasons.

Season	Character	Irrigation termination date (days after complete heading)						LSD 5%
		0	5	10	15	20	25	
2016	Plant height (cm)	89.30	89.53	91.62	90.10	90.25	89.70	NS
	No. of panicles/m^2	437.5	466.5	443.1	486.0	445.8	448.8	NS
	Panicle length (cm)	20.16	21.00	20.17	20.85	20.80	19.50	NS
	No. of grains/panicle	110.90	127.25	133.30	136.25	137.00	127.00	9.42
	Unfilled grain (%)	13.00	8.40	7.15	5.35	4.65	4.92	3.49
	Panicle weight (g)	2.64	2.86	2.93	3.13	3.23	3.00	0.36
	1000-grain weight (g)	24.45	26.87	26.75	27.17	27.20	27.88	1.44
	Grain yield (t/ha)	6.97	7.28	9.79	11.08	11.98	11.77	0.93
	Straw yield (t/ha)	14.17	14.78	14.92	15.09	15.02	14.94	NS
2017	Plant height (cm)	88.67	88.95	88.00	90.85	89.95	89.20	NS
	No. of panicles/m^2	423.8	402.5	447.5	412.5	413.8	406.3	NS
	Panicle length (cm)	19.70	19.85	19.40	20.60	18.85	18.85	NS
	No. of grains/panicle	117.80	122.15	124.40	127.30	129.15	123.75	6.80
	Unfilled grain (%)	13.48	10.20	5.10	5.08	5.65	4.40	2.14
	Panicle weight (g)	2.42	2.66	2.86	3.18	3.29	3.02	0.38
	1000-grain weight (g)	24.77	25.00	25.22	25.95	26.37	26.52	0.87
	Grain yield (t/ha)	6.46	7.35	9.11	10.90	11.89	11.34	0.95
	Straw yield (t/ha)	13.53	14.56	15.10	15.31	15.14	15.00	1.14

NS = Not significant

Table (5): Physical, milling, cooking and eating quality characteristics of Giza 179 rice cultivar as affected by irrigation termination in 2016 and 2017 seasons.

Season	Character	Irrigation termination date (days after complete heading)						LSD 5%
		0	5	10	15	20	25	
2016	Physical characteristics							
	Grain length (cm)	5.27	5.41	5.56	5.74	5.72	5.66	0.22
	Grain width (cm)	2.41	2.52	2.64	2.68	2.61	2.66	0.17
	Grain shape	2.19	2.15	2.11	2.15	2.20	2.13	NS
	Milling quality							
	Hulling (%)	67.42	77.52	78.67	78.77	79.25	79.00	1.50
	Milling (%)	62.67	67.00	68.28	69.00	69.65	69.75	1.91
	Head rice (%)	50.15	54.53	57.05	61.65	63.83	63.25	3.46
	Cooking and eating quality							
	Amylose content	19.13	19.06	18.87	18.31	18.08	17.76	0.58
	Gel consistency	91.56	90.56	89.95	89.03	88.21	88.19	0.39
	Gelatinization temperature	6.75	6.50	7.00	6.50	6.50	6.00	NS
2017	Physical characteristics							
	Grain length (cm)	5.36	5.41	5.50	5.62	5.62	5.60	0.18
	Grain width (cm)	2.46	2.57	2.65	2.67	2.68	2.67	0.13
	Grain shape	2.19	2.11	2.07	2.11	2.10	2.10	NS
	Milling quality							
	Hulling (%)	73.50	75.70	76.30	77.82	78.32	78.40	1.24
	Milling (%)	64.87	66.04	67.35	69.01	69.52	69.47	2.52
	Head rice (%)	47.97	53.97	57.63	62.15	62.83	62.95	2.90
	Cooking and eating quality							
	Amylose content	18.89	19.20	18.94	18.84	17.76	17.66	0.59
	Gel consistency (mm)	92.01	90.53	89.84	88.91	88.27	88.11	0.48
	Gelatinization temperature	6.50	6.50	6.75	6.25	6.50	6.25	NS

NS = Not significant

C- Cooking and eating quality:

Amylose content and gel consistency were significantly responded by varying water termination treatments. However, gelatinization temperature was not significantly influenced with respect to withholding irrigation treatments during both the years Table 5. In first season, the maximum amylose content was produced in case of treatments 0 DACH (19.13 %) followed by 5 DACH (19.06%) and 10 DACH (18.87 %). While, in the second season the maximum amylose content was obtained by treatment of 5 DHCH (19.20 %) followed by 10 DACH (18.94 %) and 0 DACH (18.89 %) which were statistically at par with each other. The other treatments produced significantly lesser amylose content, whereas, the minimum values of amylose content (17.76 and 17.66 %) were obtained by withholding irrigation at 25 days after complete heading, in the two respective seasons. This is due to the fact that moisture stress increases amylose content of grains and there is a negative correlation of amylose content in the rice grains under moisture stress conditions Fofana *et al.* (2010). Although the significant in amylose content, it is still in low amylose content category. The results are in conformity with the findings of Omar *et al.,* (2012) and Choudhary (2016). High values of gel consistency (91.56 and 92.01) were associated with early cut-off irrigation at ACH, and gel consistency gradually declined to reach the lowest values (88.19 and 88.11) at later cut-off irrigation dates at 25 DACH, in the two respective seasons.

Finally, it could be concluded that a planting date of 1st and 10th May might enable to achieve high grain yield for Giza 179 rice cultivar . However, delayed planting up to 20th May achieve acceptable grain quality. On the other hand, maximum grain yield combined with high grain quality seem to be associated with delaying water termination up to 20 days after complete heading.

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تأثير مواعيد الزراعة والفطام على الإنتاجية وجودة الحبوب لصنف الأرز جيزة 179

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مركز البحوث الزراعية– معهد بحوث المحاصيل الحقلية– مركز البحوث والتدريب فى الأرز– سخا– كفر الشيخ

الملخص العربى

تعتبر مواعيد الزراعة ونظم توقف الري من الجوانب الهامة فى نجاح إنتاج الأرز، ولذلك أُقيمت تجربتان حقليتان خلال موسمي الزراعة 2016 و2017 م وذلك لتقدير تأثير مواعيد مختلفة للزراعة والفطام على الإنتاجية و بعض صفات الجودة لصنف الأرز جيزة 179 وذلك فى المزرعة البحثية لمحطة البحوث الزراعية بسخا – كفر الشيخ – جمهورية مصر العربية. استُخدم تصميم القطاعات كاملة العشوائية، في أربع مكررات. فى التجربة الأولى، تم دراسة تأثير خمسة مواعيد للزراعة (20 أبريل ، 1 مايو، 10 مايو، 20 مايو، 1 يونيو) بينما فى التجربة الثانية فقد تم دراسة تأثير ستة مواعيد للفطام (توقف الري عند تمام طرد الداليات) وذلك مباشرة بعد صفر ، 5 ، 10 ، 15 ، 20 ، 25 يوم من تمام طرد الداليات ويمكن إيجاز أهم النتائج فيما يلى :

1- وقد أوضحت نتائج التجربة الأولى أن ميعاد الزراعة المبكر فى 20 ابريل أدي إلى زيادة عدد الأيام حتى 50 % تزهير، بينما أدى التأخير فى الزراعة عن 10 مايو إلى نقص فى طول النباتات. سجل ميعاد الزراعة المبكر (20 أبريل) والمتوسط (1 ، 10 مايو) أعلى القيم لعدد الداليات و طول الدالية وعدد الحبوب/ دالية وزن الدالية ووزن 1000 حبة و محصول الحبوب و القش. بينما سجلت مواعيد الزراعة المتأخرة (20 مايو ، 1 يونيو) نقصا معنويا فى جميع الصفات السابقة و كذلك أعلى نسبة للحبوب الفارغة. زادت تدريجيا قيم كلا من طول و شكل الحبة و كذلك نسبة التبييض و نسبة الحبوب السليمة مع التأخير فى ميعاد الزراعة. و تشير النتائج أيضا إلى تأثر محتوى الأميلوز معنويا بمواعيد الزراعة المختلفة بينما لم يكن هناك تأثير لمواعيد الزراعة على تماسك الجيل و درجة حرارة الجلتنة للحبوب.

2- أوضحت نتائج التجربة الثانية أن مواعيد الفطام (توقف الري مباشرة بعد طرد الداليات) لم يكن لها تأثيرا معنويا على طول النباتات و عدد الداليات/م2 و طول الدالية. بينما أدى التأخير فى مواعيد الفطام (توقف الري مباشرة بعد تمام طرد الداليات) إلى زيادة معنوية لقيم كلا من محصول الحبوب و مكوناته (عدد الحبوب/دالية و وزن الدالية ووزن 1000 حبة)، و ذلك بالمقارنة بتوقف الري مبكرا عند تمام الطرد والذي سجل أعلى القيم لنسبة الحبوب الفارغة. لم تسجل اى اختلافات معنوية فى محصول الحبوب بين آخر ثلاثة مواعيد للفطام (توقف الري بعد تمام الطرد) و ذلك فى الموسم الأول و بين أخر ميعادين للفطام فى الموسم الثاني. سجلت معاملة الفطام (الحرمان من الري مبكرا عند تمام الطرد) أقل القيم لصفات طول وعرض الحبة و صفات التبييض (نسب التقشير و التبييض و الحبوب السليمة) ومحتوى الأميلوز و ذلك بالمقارنة مع مواعيد توقف الري الأخرى.

وأخيرا ، يمكن التوصية بأن مواعيد الزراعة فى 1 ، 10 مايو قد أدت إلى الحصول على أعلى القيم لمحصول الحبوب وذلك لصنف الأرز جيزة 179 ، بينما سجلت بعض صفات الجودة المقبولة للحبوب مع ميعاد الزراعة فى 20 مايو. وعلى الجانب الأخر، سجلت أعلى القيم لمحصول الحبوب و صفات الجودة المقبولة مع تأخير الفطام (توقف الري) بعد 20 يوم من تمام طرد الداليات.

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