MORPHOLOGICAL ASPECTS OF SOME NEWLY, CULTIVARS AS AFFECTED BY IRRIGATION INTERVAL AND TRANSPLANTING SPACING

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Abstract

A two-year experiment was carried out on rice (Oryza sativa L), during 2006 (S I) .and 2007 (S2), at the Rice Research and Training Center (RRTC) at Sakha, Kafr El-Sheikh Governorate, Egypt. The .trail included three factors, viz. irrigation intervals (6 "1-6", 9 "1-9" and 12 "1-12'" days), three rice cultivars (Sakha 101"Sk-IOI", Sakha 103 "Sk-I03" and Sakha 104 "Sk-104") and three plant spacing (15x15 "PSI", 15x20 "PS2" and 15x25 "PS3" cm). A split-split plot design was used. Experimental plot area was 15 m^2. Eight traits were studied. The obtained results showed the following: All the three main factors significantly affected all aspects. The first order interactions differed in their effects according to the studied traits. But they agreed in their significant effect on grain yield/plant The second order interaction effect was insignificant on all aspects. The highest values on most traits, except light penetration, were measured on 1-6, Sk-101 and PSI. Oppositely, 1-12, Sk-104 and PS3 gave the lowest values. In addition, 1-9, Sk-103 and PS2 were in between. The pronounced product of first order interactions, viz., (1-6xSk-IOI), (I-6xPSI) and (Sk-IOlxPSI) produced the superior grain yield/plant, viz. (26.72,22.74), (26.06, 20.86) and (26.53, 22.45) gm in SI and S2, respectively. The second order interaction (1-6xSk-101 x PSI) yielded the greatest yields/plant, viz 32.98 and 25.17 gm in SI. and S2, respectively .

Key words: Rice, Irrigation intervals, cultivars, plant spacing, morphological traits and yield.

INTRODUCTION

Rice is a main cereal crop all over the world. It is considered as the most important food for about the half of the world population, contributing about 20% of cereals consumption. Moreover, it is the principle food of the majority of Egyptians. FAOSTAT (2005) stated that the Egyptian total consumption, production and export of milled rice were 3.28, 3.74 and 1.07 million ton, respectively. But, in the few last years rice cultivation vigorously cxtended and cxceeded the three previous estimations. Thereafter, rice mainly replaced cotton and maize areas, becoming as the major summer crop on the agricultural map. Moreover, rice cultivation is very important for conservation of soil fertility and reducing salinity hazard, in particular arcas in Northern Delta .

Egypt is complctely depended on water from River Nilc (55.5 Milliard m^3, yearly). Agriculture utilizes about 90% of available water. Rice alone consumed more than 20% of such water. Therefore, there is a keen need to find the way for saving more irrigation water. No doubt, the government rightly intends to cut rice growing areas by almost 50% of its current plantings, more than two millions fed., (1 fed = 4200.78 m^2). Also, one of the main strategies to overcome this problem is to achieve better water management policy .

The successful fit policy of water saving depends on some factors including prolonging irrigation interval, use of early rice cultivars and good weed control.

Ibrahim et al (1988) reported that irrigation every 6 days along the growing season gave reasonable production of rice. Several researcllers showed that rice can normally grow with high yield under shallow water depth than under deep onc.' Generally, rice shows better growth and higher yield under continuous flooding than exposing to water deficit at certain. growth stages. In this respect, Nour et al, (1994) reported that exposing rice plant to water stress significantly reduced plant height, No. of tillers/plant and grain yield. They added that rice plants can tolerate water deficit for 12 days through four week after transplanting. They concluded that highest saving of irrigation water was found when irrigation interval increased from 4 to 12 days . Irrigation interval of 6 days are recommend for paddy rice in Egypt. EI-Wehishy and Hafcz , (1998) as well as El-Refaee et al, (2004) found that grain yield and yield components dccreased by increasing irrigation interval up to 14 and 9 days for the former and latter authors, respectively. Abou EI-Hassan, (1997) and EI-Kalla et al, (2006) concluded that irrigation interval longer than 6 days caused great reduction in plant height, No. of panicles/m^2, panicle length, and grain yield. Abou Khalifa et al (2005), found simi1ar results on panicle length. El-Kalla et al, (2006), confirmed the previous results .

The Egyptian National Program of Rice Research lies in releasing new cultivars group of short duration, to save about 20-30% of local water consumption. Such group includes Sakha. 101 (135 days), Sakha 103 (125 days) arid Sakha 104 (135 days). Many researches have shown that rice cultivars differ in their growth and grain yield. Some studies corifirmed the superiority of Sakha 10l over Giza 177, Abou EI-Hassan (2006) and Sakha on 104 (RRTC 2003). In addition, Abd EI-Maksoud, (2008) pointed out that Sakha 103 out yielded Sakha 104 as respects yield and most yield components. Oppositely, Sakha 104 exceeded Sakha 103 in their yields, EI-Refaee et al, (2004) as well as Fawzi et al (2006). In addition, El-Kalla et al, (2006) found that Sakha 104 surpassed Giza 182 with respect of yield and most studied yield components .

Plant spacing had a significant role on irrigation regime. Wider spacing increases the evaporation from ,the soil surface and consequently increases evapotranspiration. Also, it may also 'enhances the growth of accompanied weeds which consume water as or higher than rice itself. The wider space' (20x25 cm) gave the lowest rice grain yield values. On the contrary, it was observed that the narrowest plant spacing (15x20 cm) recorded the highest values of plant height, leaf area index and days after sowing (DAS) to 50% heading, versus the other spaces' Zahran (2000) and Zayed et al (2005). Sultan and Kaleem, (2005) reported that (20x20 cm) spacing resulted in ' higher values on plant height and panicle length .

Egyptian rice cultivars produced higher yield when water control of soil is kept near saturation through out the season Badwi Tantawi (2004). El-Refaee et al, (2004) approved positive interaction between 3-day interval and both Sakha 101 and Sakha 104. Abou El-Hassan, (1997) found similar interaction between 6 days interval and Sakha 101 cv. He added that such effect saved 8.6% of watering. El Kalla et al, (2006) pointed out that Sakha 104 cultivar was more tolerant to lengthen irrigation interval. Ibrahim et al, (1995) and Abou El-Hassan et al, (2006) found insignificant interaction between irrigation and cultivars .

As regards the interaction between cultivar x spacing, Badawi Tantawi and Ghanem, (2004) reported that plant spacing depended upon the variety and its tillering ability. However, a variety with low ability can grow in narrow spacing and inverse .

The current study aimed to investigate the effect of irrigation intervals, spacing of transplanting on the morphological aspects of three newly rice cultiv'ars.

The final targct was to develop a combination among the three factors giving good growth features and high rice yield .

MATERIALS AND METHODS

A two year trail was carried out in Sakha, Kafr El Sheikh Governorate, Egypt in 2006 (SI) and 2007 (S2). The study included three rice cultivars, three watering intervals and three plant spacings

In both seasons, samples for soil analyses were taken from the layer 0.0-30.0 cm depth. Such samples were tested in the laboratory, according to Black, (1965). The chemical, and physical properties of the soil are presented in (Table,1).

Table 1. Some chemical and physical properties of soil, average over the two seasons.

Chemical analysis				**Physical analysis**	
pH.	8.1	Available K (ppm).	412.50	Sand%.	12.95
EC ds/m.	2.0	Available Zn (ppm).	0.85	Silt %.	32.90
Organic matter%.	1.9	Available Fe (ppm).	2.45	Clay %.	54.15
Available N	17.0		3.35	Soil Texture.	Clay
Available P	16.5				

Agricultural practices: In both seasons, the preceded crop was Egyptian clover. Seedbed of the nursery, area of 350 m^2 for 1 fed. was well prepared and fertilized with calcium super phosphate (15.5% P_2O_5) at 100 kg/fed. before ploughing. Rice commercial grains of the three cultivars were soaked in running water for 48 hr., then incubated for 48 hr too. Before seeding, 10 kg/fed. of zinc sulphate were added. Seeds were handly broadcasted in the nursery on April 20th, at 60 kg/nursery. At 7 days age, weeds were chemically controlled by Saturn 50% (Thiobencarb) at 2 litres dissolved in 100 litres of water/fed. and sprayed by a knapsack sprayer. Two weeks after sowing, a rate of 40 kg N/fed. was added at once as urea (46% N). Before transplanting, permanent field was well prepared, calcium super phosphate 15.5% P_2O_5, at rate 100 kg/fed. was added on the dry soil before ploughing. Flushing irrigation was done. Nitrogen as ur:ea (46% N) was applied in two rates; two-third in dry soil before transplanting and the remainder third at panicle initiation. Transplanting of seedlings from nursery to permanent field was done 25 days after sowing. Planting was spaced at the tested spacing, as three plants hill. After four days, weeds were controlled by Saturn 50% as previously mentioned. Irrigation was with held 15 days before harvest. Harvest was carried out according to each cultivar duration. All remainder agricultural, practices were carried out as usual .

Treatments: The tested three cultivars are characterized as short grain, resistant to blight disease and 72% milling. Such, cultivars differ in grain yield (more than 5.0, 4.0-4.5 and 4.0-5.0 ton/fed.) and to maturity time (135,125 and 135 days), for Sk-l01, Sk-103 and Sk-l04, respectively.

Irrigation discharge was adjusted by using triangular weirs (V notch). The height of flowing water was fixed at 30 cm. Water discharge was counted according to the equation of Hansen et al, (1980), as follows :

$Q = 0.0138 \times h^{25} \times 3.6$ where :

Q = Water discharge, m3/hr .

0.0138 and 3.6 = constant values, where 3.6 was added for obtaining Q in m^3/hr .

h= Water height, (cm).

The used irrigation regime is illustrated in (Table, 2).

Table 2. Irrigation interval, day, total applied water (TAW), (m^3/fed.), number of irrigations and quantity of each one, (m^3/fed.).

Irrigation interval, (day)	Total applied water (TAW) m'/fed.•	Number of irrigations	Quantity of fone. irrigation (m^3/fed).
1-6	5000**	16	312.5
1-9	4500**	10	450.0
1-12	4000	8	500.0

Notes :

• Without flushing irrigation .

•• The quantities were reduced by 312.5 and 450.0 m3/fed, with respect to Sk-103 cv, for its short duration, i.e. 125 day .

The studied treatments and their levels are summarized in the following :

A-Irrigation intervals	B- Cultivars	C-Plant spacing
1-Irrigation every 6 days, 1-6.	1- Sakha 10l, Sk.101 .	1- (15x15cm), (PS1).
2-Irrigation every 9 days, 1-9.	2- Sakha 103, Sk.103 .	2- (15x20cm), (PS2).
3-Irrigation every 12 days, 1-12.	1- Sakha 104, Sk.104 .	3- (15x25cm), (PS3).

Experimental Design:

A split-split plot design with three replicates was used. The main plots were devoted to irrigation intervals, the sub-ones were occupied by cultivars, while spacing were randomly distributed at the sub-sub plots. Plot area was 15.0 m^2 (3x5) m .

Studied Traits: At heading and at the end of the season, eight traits were studied. A random sample were taken from the inner plant of each experimental plot. The studied traits are put in the following list :

1. Plant height (cm).
2. Leaf area index: by a meter ; Minolta Camera Co. Ltd .
3. Light penetration, by a Lux/meter Pu ISO K-Pu.
4. Total Chlorophyll content, by Chlorophyll meter 5 SPAD-502 Minolta Camera Co. Ltd .
5. Days after sowing (DAS) to 50% heading .
6. No. of panicles/plant.
7. Paniclc length (cm).
8. Grain yield/plant (gm).

However, the traits numbered in above list as 2,3 and 4 were studied at heading, while the remainder ones were at harvets .

Statistical Analysis:

In both seasons, data were subjected to analysis of variance. Means were compared by Duncan's (1955) multiple range test at a 0.05 level of significance. Simple correlation coefficients were estimated among every trait and all the remainder seven ones. Coefficients of correlation were tested at a 0.01 level of significance. AII statistical procedures were performed as described by Snedecor and Cochran (1981) as well as Gomes and Gomes (1984). In data presentation, means having the same letter are not significantly different .

RESULTS AND DISCUSSION

A: Main effects :

1- Irrigation interval: Table (3) shows that, in both seasons, all studied traits significantly differed according to irrigation interval. With all traits, except light penetration, a gradual and significant. decrease from 1-6 interval to 1-12 one was observed. The opposite was quite true as respects light penetration trait. It seemed that sufficient watering as with 1-6 interval may promoted the biological processes in the plant cells, such as cell division, expansion and enlargement. Consequently, plants were ·taller (88.49 cm in SI) and (79.84 cm in S2) with 1-6 interval .

On the other hands, water shortage as in 1-12 interval probably retarded such biological processes giving shorter plants, viz. (48.6S cm in SI and 62:27 cm in S2). These findings are in full agreement with tboseereported by Nour et al, (19941) and EI-Kalla et al, (2006).

Table 3: Plant height (cm), leaf area index, light penetration and total chlorophyll content, as affected by irrigation intervals, cultivars and plant spacing and their interactions in the two seasons.

Treatments	Plant height (cm)		Leaf area index		Light penetration		Total chlorophyll content	
	S1	S2	S1	S2	S1	S2	S1	S2
I-6	88.49 a	79.8 a	6.89 a	6.66 a	1857. c	1808. c	33.96 a	38.99 a
I-9	76.39 b	71.5 b	6.43 b	6.10 b	2086. b	2035. b	26.45 b	32.16 b
I-12	48.65 c	62.2 c	5.62 c	5.54 c	2330. a	2316. a	24.04 c	28.55 c
Sk-101	67.51 b	66.5 c	7.28 a	6.99 a	1936. c	1910. c	33.34 a	40.44 a
Sk-103	72.66 a	72.7 b	5.62 c	5.48 c	2275. a	2223. a	23.51 c	26.05 c
Sk-104	73.37 a	74.3 a	6.04 b	5.82 b	2061. b	2026. b	27.59 b	33.22 b
Ps1	87.85 a	78.8 a	6.80 a	6.59 a	871.9 c	824.2 c	31.33 a	35.97 a
Ps2	69.26 b	71.3 b	6.46 b	6.19 b	1549. b	1525. b	28.23 b	33.21 b
Ps3	56.42 c	63.5 c	5.68 c	5.52 c	3852. a	3811. a	24.88 c	30.52 c
I-6xSk-	83.93	74.6	7.94	7.64	1720. g	1683. g	40.22 a	47.44 a
I-6xSk-	90.33	81.5	6.13	5.99	2020. d	1958. d	28.36 d	30.56 e
I-6xSk-	91.22	83.3	6.59	6.36	1830. f	1785. f	33.29 b	38.97 b
I-9xSk-	72.45	66.9	7.41	6.99	1932. e	1893. e	31.33 c	39.13 b
I-9xSk-	77.98	73.0	5.72	5.49	2270. b	2203. b	22.09 g	25.21 g
I-9xSk-	78.74	74.7	6.15	5.83	2056. d	2008. d	25.93 e	32.14 d
I-12xSk-	46.14	58.2	6.49	6.35	2158. c	2155. c	28.47 d	34.74 c
I-12xSk-	49.66	63.5	5.01	4.98	2535. a	2508. a	20.08 h	22.38 h
I-12xSk-	50.14	65.0	5.38	5.29	2297. b	2286. b	23.57 f	28.54 f
I-6xPs1	109.2 a	88.3	7.42	7.20	774.3 h	725.9 h	37.79	42.19
I-6xPs2	86.11 c	79.9	7.05	6.76	1375. f	1343. f	34.06	38.96
I-6xPs3	70.14 e	71.2	6.19	6.02	3421. c	3357. c	30.02	35.81
I-9xPs1	94.28 b	79.2	6.93	6.60	869.8 g	816.8 h	29.44	34.80
I-9xPs2	74.33 d	71.6	6.58	6.19	1545. e	1511. e	26.53	32.14
I-9xPs3	60.55 f	63.8	5.78	5.52	3843. b	3777. b	23.38	29.54
I-12xPs1	60.04 f	68.9	6.06	5.99	971.7 g	929.8 g	26.76	30.90
I-12xPs2	47.34 g	62.3	5.76	5.62	1726. d	1720. d	24.11	28.54
I-12xPs3	38.56 h	55.5	5.06	5.01	4293. a	4309. a	21.25	26.22
Sk-101xPs1	83.32	73.7	7.85	7.56	807.6	766.9	37.11	43.76
Sk-101xPs2	65.69	66.6	7.45	7.10	1434.	1419.	33.44	40.41
Sk-101xPs3	53.51	59.3	6.55	6.32	3568.	3546.	29.47	37.14
Sk-103xPs1	89.68	80.4	6.06	5.93	948.8	892.2	26.17	28.19
Sk-103xPs2	70.70	72.8	5.75	5.56	1685.	1650.	23.59	26.03
Sk-103xPs3	57.59	64.8	5.05	4.96	4192.	4126.	20.78	23.92
Sk-104xPs1	90.55	82.3	6.51	6.29	859.5	813.4	30.71	35.95
Sk-104xPs2	71.39	74.4	6.18	5.91	1527.	1505.	27.68	33.19
Sk-104xPs3	58.15	66.3	5.43	5.27	3797.	3762.	24.39	30.51

Similar enhancing effect due to sufficient irrigation was detected on leaf area index. However, leaf under these circumstances became wider and lengthener producing larger area and consequently area index. EI-Refaee et al, (2004) found similar results. Total chlorophyll is the direct product of the leaf, limiting its ability to fit photosynthesis. However, if water status within the Icaf is suitable, higher chlorophyll content can be expected, (Table, 3). Similar results were obtained in the study of Victor and Reuben (2000), who concluded that light intensity could be inversely related to the develop of rice canopy. Saleh, (2003) on artichoke found that reducing water applied resulted in a reducdon of chlorophyll content In addition, Song-Ping Hu et al, (2009) reported significant positive correlation between chlorophyll content and photosynthetic rate. Light penetration presents an adverse express. However, greater number and larger area of leaves prevent light to penetrate. Thus, sufficient watering of 1-6 interval which gave taller plants and greater leaf area index could be correlated with the lowest light penetration record, viz. 2330.62 in SI and 2316.95 in S2. In other words, a negative'relation between light penetration and each of irrigation quantity and full canopy, could' be observed, (Table, 3) .

DAS to 50% heading is one of the most traits affecting by watering. However, shortening irrigation intervals to 6 days encouraged vegetative growth as mentioned, hence delayed heading, (Table, 4). Consequently; I·6 interval needed 133.96 and 120.73, days in the two successive seasons to push 50% of rice plants to heading. Oppositely, lengthening irrigation to 1-12 allowed rice plants to early heading after 73.64days in SI and 94.16 days in S2, (Table, 4).

Table 4: DAS to 50% heading; No. of panicles/plant, panicle length (cm) and grain yield/plant (g), as affected by irrigation intervals, cultivars and plant spacing and their interactions in the two seasons..

Treatments	DAS to 50% heading		No. of panicles/plant		Panicle length (cm)		Grain yield/plant (g)	
	S1	S2	S1	S2	S1	S2	S1	S2
I-6	133.96 a	120.73 a	17.64 a	15.91 a	25.86 a	25.57 a	21.11 a	18.84 a
I-9	115.64 b	108.22 b	15.23 b	14.26 b	24.43 b	24.10 b	18.23 b	16.89 b
I-12	73.64 c	94.16 c	9.70 c	12.41 c	23.02 c	22.73 c	11.61 c	14.70 c
Sk-101	113.02 a	112.01 a	15.90 a	14.92 b	26.31 a	25.94 a	21.49 a	20.29 a
Sk-103	102.79 c	102.75 c	11.67 c	11.67 c	22.76 c	22.62 c	14.33 c	14.19 c
Sk-104	107.43 b	108.35 b	15.00 b	15.98 a	24.25 b	23.84 b	15.12 b	15.95 b
Ps1	132.99 a	119.22 a	17.52 a	15.71 a	25.81 a	25.67 a	20.96 a	18.61 a
Ps2	104.85 b	107.85 b	13.81 b	14.21 b	24.45 b	24.15 b	16.52 b	16.83 b
Ps3	85.40 c	96.04 c	11.25 c	[illegible]	23.05 c	22.58 c	13.46 c	14.99 c
I-6xSk-101	140.51	125.55	19.77 a	[illegible]	27.84	27.49	26.72 a	22.74 a
I-6xSk-103	127.80	115.18	14.51 e	[illegible]	24.09	23.96	17.82 d	15.90 d
I-6xSk-104	133.57	121.46	18.65 b	17.91 a	25.66	25.26	18.80 c	17.88 c
I-9xSk-101	121.29	112.54	17.07 c	14.99 d	26.30	25.91	23.06 b	20.38 b
I-9xSk-103	110.32	103.24	12.52 f	11.72 g	22.76	22.59	15.38 f	14.26 e
I-9xSk-104	115.30	108.87	16.10 d	16.06 c	24.24	23.81	16.23 e	16.03 d
I-12xSk-101	77.24	97.92	10.87 g	13.05 f	24.78	24.43	14.69 g	17.74 c
I-12xSk-103	70.25	89.83	7.97 i	10.20 h	21.44	21.30	9.80 i	12.40 f
I-12xSk-104	73.42	94.73	10.25 h	13.97 e	22.84	22.46	10.33 h	13.95 e
I-6xPs1	165.34 a	133.64	21.78 a	17.61	27.32	27.20	26.06 a	20.86
I-6xPs2	130.36 c	120.90	17.17 c	15.93	25.88	25.59	20.54 c	18.87
I-6xPs3	106.18 e	107.65	13.98 e	14.18	24.40	23.93	16.74 e	16.80
I-9xPs1	142.73 b	119.79	18.80 b	15.78	25.81	25.64	22.50 b	18.69
I-9xPs2	112.53 d	108.37	14.82 d	14.28	24.45	24.12	17.73 d	16.91
I-9xPs3	91.66 f	96.50	12.07 f	12.71	23.04	22.55	14.45 f	15.06
I-12xPs1	90.89 f	104.23	11.97 f	13.73	24.31	24.18	14.32 f	16.27
I-12xPs2	71.66 g	94.29	9.44 g	12.42	23.03	22.74	11.29 g	14.72
I-12xPs3	58.37 h	83.96	7.69 h	11.06	21.71	21.26	9.20 h	13.10
Sk-101xPs1	139.49	123.98	19.63 a	16.52	27.79	27.60	26.53 a	22.45
Sk-101xPs2	109.98	112.16	15.43 c	14.94	26.32	25.96	20.91 b	20.31
Sk-101xPs3	89.58	99.87	12.61 e	13.31	24.81	24.27	17.03 d	18.09
Sk-103xPs1	126.87	113.73	14.40 d	12.92	24.04	24.06	17.69 d	15.71
Sk-103xPs2	100.03	102.90	11.35 f	11.69	22.78	22.63	13.95 e	14.21
Sk-103xPs3	81.48	91.62	9.25 g	10.40	21.47	21.16	11.36 f	12.65
Sk-104xPs1	132.60	119.94	18.51 b	17.69	25.61	25.37	18.66 c	17.66
Sk-104xPs2	104.54	108.50	14.60 d	16.00	24.27	23.86	14.71 e	15.97
Sk-104xPs3	85.15	96.62	11.89 f	14.25	22.87	22.31	11.98 f	14.22

* The significant second order interaction are only included in the table .

Table 4: Continue

I-12xPs2	25.16	24.62	8.66	7.78	2.41	g	3.26	21.89	i	29.60	h	0.64	e	0.86
I-12xPs3	26.95	25.98	6.67	5.94	1.97	h	2.90	22.84	h	32.87	c	0.52	f	0.76
Sk-101xPs1	21.01	21.45	9.65	8.80	5.28	a	4.69	34.84	a	34.69	c	1.15	a	1.04
Sk-101xPs2	22.35	22.60	8.61	7.77	4.15	c	4.24	32.07	c	35.26	b	0.91	c	0.94
Sk-101xPs3	23.95	23.85	6.63	5.93	3.38	e	3.77	33.24	b	38.83	a	0.74	e	0.84
Sk-103xPs1	21.94	21.58	10.54	9.73	4.41	b	4.10	29.06	d	29.60	f	1.02	b	0.97
Sk-103xPs2	23.34	22.74	9.40	8.59	3.47	e	3.71	26.54	f	30.13	e	0.81	d	0.87
Sk-103xPs3	25.01	23.99	7.24	6.55	2.82	f	3.30	27.62	e	33.48	d	0.66	f	0.78
Sk-104xPs1	23.97	23.20	11.46	10.61	3.80	d	3.57	24.54	g	25.16	i	0.83	d	0.79
Sk-104xPs2	25.51	24.44	10.22	9.36	2.98	f	3.23	22.28	i	25.62	h	0.65	f	0.72
Sk-104xPs3	27.34	25.79	7.88	7.15	2.43	g	2.88	23.25	h	28.67	g	0.53	g	0.64

* Only the significant second order interaction are presented in the table .

Number of panicles/plant is a direct maker of grain yield. Such trait was, in the present study, positively correlated by shortening irrigation interval. Thus, higher watering quantities mean greater No. of panicles/plant, viz. 17.64 and 15.91 in the two respective seasons, (Table, 4). The results herein are in convenient agreement with those of El-Refaee et al (2004) and el Kella et al (2006).

In spite of the importance of No. of panicles/plant as a real maker of grain yield, such importance could be completed by the length of the panicle itself, (Tabie, 4). panicles length is a carrier area of spikelets and grains. In other words, sufficient watering could induce panicle length and made it longer, forming greater spikelets and grains number. Such results confirmed those of Abou Kahlia et al (2005).

Grain yield/plant, as the final result of the previous contributors typically followed their tendency . It seemed that the promoting effects of 1-6 interval (sufficient water) on previous traits were turn in grain yield /plant. Highest grain was 21.11 and 18.84 gm in the two respective seasons. On the other hand, lengthening interval to 1·12 interval gave grain yicld/plant of 11.61 and 14.70 gm in the same seasons, respectively. Irrigation every 9 days (1-9) yielded in between, (Table, 4). EI-Wcishy and Hafez, (1998) as well as Abou Khalifa et al, (2005) came to similar trends .

2- Cultivars: In both seasons, all studied traits were significantly affeetcd by tested cultivars, (Table, 3). There was no ccrtain trend among eultivars as respccts different traits. The wide superiority detccted on Skk 101, in both seasons, was observed on leaf area index, chlorophyll content (Table, 3) and DAS to 50% heading, panicle length and grain yield/plant, (Table, 4). In addition, Sk-I 0 I gave in the first season the highest No. of panicles/plant. While Sk- 104 cv surpassed the others with respect to plant height. Moreover, Sk-104 gave the highest No. of panicles/plant in the second season, (Table, 4). A general view illustrated that Sk-101 was the superior followed hay Sk-104 then Sk-101, cv. Meanwhile Sk-103 was the most able one, allowing light penetration in both seasons .

Such results may 'be explained and accepted however Sk-103 gave the poorest canopy, consequently the highest light penetration values in the two seasons. Poorest canopy means the lowest chlorophyll content and leaf area index which are main makers of yield. On the reverse, Sk-101 with its superiority previously mentioned on most grain yield attributes, larger vegetative canopy, higher leaf area index and chlorophyll content could benefited their positive effects releasing the maximal grain yield/plant. Sk-103 cv occupied the middle position in all studied traits including grain yield/plant. Generally speaking, cultivars normally differ because of their different genotypes .

The superiority of Sk-101 was confirmed by many authors, of them RRTC, (2003), Abou EI- Hassan et al, (1997). Many researchers reported surplus in favor to Sk-I04 over Sk-103 El Kalla et al (2006) . Oppositely, EI-Rewainy, (2002), Abd EI-Maksoud (2002) and Sallam, (2005), found that Sk-103 out yielded Sk-104, cv.

3-Spacing: Tables (3 and 4) indicate that spacing levels significantly affected all traits. A general trend was observed, however the closer spacing (I5x15 cm) achieved the highest values with all aspects, except light penetration. The middle space (I5x20 cm) followed the closer one. Then the wider spacing (I5x25 cm). This means that the narrow cultivation pushed rice plants to compete about light and tended to produce taller plants (87.85 and 78.84 cm) in the two respective seasons. Similarly, such narrow spaces promoted the other studied traits giving a full canopy, making difficult to light penetration. Oppositely, widest spacing (I5x2S) may allow rice to grow without self competition which gave shorter plants with limited canopy, allówing good light penetration. Such results mean that grain yield/plant may received positive products from the studied traits giving the highest grain yield/plant, viz. 20.96 gm in S I and 18.61 gm in S2, (Table, 4). The present results are in line with those found by Zahran, (2000) Zayed et al (2005) Salem, (2006) . The latter author concluded that narrowest plant spacing (15x20 cm) recorded the highest values of plant height, leaf area index and days to 50% heading. On the other hand, Gautam et al (2005) reported that wider plant spacing (20x20 cm) yielded higher than the narrowest spacing by about 6.2%. Moreover, Sultan and Kaleem (2008) found results in favour to the wider (20x20 cm) spacing, as respects plant height and panicle length

B- Interection effects :

1- First order interaction :

a- Irrigation x cultivars: Each of water effect and cultivars performance is well documented in the literature. However, little is known, about their integrated effect. Data demonstrate that significant differences were detected, in both seasons, only on light penetration, chlorophy.1I content, (Table, 3), No. of panicles/plant and grain yield/plant, (Table, 4). It was clear that the (I-6xSk-101) combination gave, in the two respective seasons, the highest values on leaf area index (7.94 and 7.64), chlorophyll content (40.22 and 47.44), (Table, 3), DAS to 50% heading (140.51 and 12S.55 days), panicle length (27.84 and 27.49 cm) and grain yield/plant (26.72 and 22.74 gm), (Tablc, 4). In addition, the previous combination yielded the highest No. of panicles/plant in the first season. This mcans that the two factors, in most cases, succeeded to interact with each other. These results arc in full agreement with Abou EI-Hassan et al, (1997). Kadum et al, (2008) found different results.

b- Irrigation x spacing:

Results give the evidence that significancy was obtained in the two seasons with light penetration, (Table, 3). In addition, similar significant difference was observed in the first season on plant 'height, (Table, 3). Table (4) presents similar effects on DAS to 50% heading, No. of panicles/plant and grain yield/plant. Such results suggest that the effect of irrigation interval under different levels of spacing was not the same. The role of irrigation x spacing appears in evapotranspiration rate increase and weed growth consuming additional water. On the contrary, the lowest products of different traits, except light penetration, were recorded by the combination of lengthening irrigation to 12 day and cultivation by the wider spacing. These finding are in agreement with those reported by Sultan and Kaleem (2008).

c- Cultivars x Spacing:

Significant differences were some what few with such combination. However, they were detected only on No. of panicles/plant and grain yield/plant in the first season, (Table, 4). Such results proposed that the effect of cultivars under studied levels of spacing was the same. Spacing plays a fundamental role with cultivars, through its effect on tillering ability of the cultivar. Therefore, a combination of Sk-10lxPSI (l5xl5 cm) maintained the greatest products on most traits. Oppositely, Sk-103xPS3 (l5x25 cm) gave the lowest valu., Also, Pawar et al, (2005) concluded' that interaction between cultivar and plant spacing was absent .

2- Second Order Interaction: The analysis of variance showed no significant effect due to the second order interaction with all studied traits. This means that each level of the three factors significantly failed to interact with all levels of the two other factors. In spite of the absence of significance, it could be recognized that the combination, (1-6 x Sk-101 x PS1), produced the highest grain yield/plant, viz 32.98 and 25.17 gm in S1 and S2, respectively .

C- Correlation:

Table (5) presents the obtained, coefficients of simple correlation between each trait and other ones. It is so clear that all estimations were highly significant. All correlations, except those of light penetration, were positive in direction. This means that traits were tightly, in force and each trait positively serves the others. As all results in the present study, light penetration gave values differ in direction, consequently its correlation coefficients with other traits were negative .

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الصفات المورفولوجية لبعض أصناف الأرز الجديدة وتأثيرها بفترة الرى

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أجريت تجربتان حقليتان على محصول الأرز فى مركز الأبحاث والتدريب بسخا محافظة كفر الشيخ – مصر خلال العامين ٢٠٠٦ ، ٢٠٠٧ – استخدم فى هذه الدراسة ثلاثة عوامل ، الأول فترة الرى I (٦ ، ٩ ، ١٢ يوم) والثانى الأصناف (SK) (سخا ١٠١ ، ١٠٣ ، ١٠٤) والثالث مسافات الشتل (PS) (١٥ X ١٥ ، ١٥ X ٢٠ و ١٥ X ٢٥) سم حيث استخدم تصميم القطاعات المنشقة مرتين فى ثلاث مكررات – احتلت معاملات القطع الرئيسية والأصناف القطع الشقية الأولى والمسافات القطع الشقية الرى مرتين .

أوضحت النتائج مايلى :

- أثرت العوامل الثلاثة معنوياً على جميع الصفات موضع الدراسة .
- اختلف تأثير التفاعلات الأحادية على الصفات ، فى حين كان التفاعل الثنائى غير معنوى فى تأثيره على الصفات جمعاء .
- سجلت القيم الأعلى لجميع الصفات ، ماعدا اختراق الضوء ، مع فترة الرى ٦ أيام ، والصنف سخا ١٠١ ومسافة الشتل (١٥ X ١٥) سم – وعلى النقيض من ذلك سجلت القيم الأدنى مع الرى كل ١٢ يوم ، الصنف سخا ١٠٤ ومسافة الشتل (١٥ X ٢٥) سم . وكانت عطاءات معاملات الرى كل ٩ أيام وسخا ١٠٣ والمساف (١٥ X ٢٠) بين المعاملتين فى هذا الشأن .

كان أعلى محصول للنبات الفردى مشاهداً مع التراكيب
(1-6 x SK 101), (I-6 x PS1), (SK 101 x PS1) and (I-6 x SK 101 x PSI).

ويمكن التوصية باستخدام المعاملة الأخيرة لإنتاج محصول نبات فردى متميز تحت ظروف التجربة والظروف المشابهة .

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