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PERFORMANCE OF ELITE AROMATIC RICE VARIETIES UNDER DIFFERENT SOWING DATES UNDER EGYPTIAN CONDITION

Metwally, T. F.[1] ; M. M. El-Malky[1] ; A. A. Glelah[2] and A. S. Gharieb[1]
1 Rice Research and Training Center, Sakha, Kafr El-sheikh, Egypt
2 Agronomy Dept., Fac. Agric., Kafrelsheikh University, Egypt.

ABSTRACT

Two field experiments were carried out at the farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Egypt, during 2008 and 2009 seasons, to evaluate some promising aromatic rice varieties (Egyptian Yasmin, IR77510-88-1-3-3, IR78530-45-3-1-3, IR 74052-177-3-3, IR 71137-51-2 and IR65610-38-2-4-2-6-3) under different sowing dates (April 24th, May 10th, May 24th and June 10th). The obtained results showed that rice plants sown on the second date (May 10th) surpassed those which sown on the late date of sowing (June 10th) in plant height, leaf area index, dry matter accumulation (g m^{-2}), tillers number m^{-2}, panicle number m^{-2}, number of filled grains panicle^{-1}, 1000–grain weight, straw yield and grain yield as well as aromatic level in both seasons. There was no significant difference between rice sown on the April 24th or May 10th in the most studied traits. Delay in sowing date significantly increased unfilled grains %, protein % and amylose content % in the two seasons. Aromatic rice varieties varied significantly in most measurements of growth, grain yield and yield attributes, in both seasons. Plants of the Egyptian Yasmin variety having the highest values in the most mentioned traits among the other tested varieties in the two seasons. Plants of Egyptian Yasmin in the two seasons and IR 77510 in the first season produced the greatest grain yield with high aroma level. Plants of IR 65610 variety produced the lowest grain yield in the two seasons. Concerning correlation coefficient among studied characters, grain yield had highly significant positive effect with 1000 grain weight and number of grains per panicle and significant positive with number of panicles m^{-2}. It can be concluded that the optimum sowing date of Egyptian Yasmin variety is April 24th and May 10th while, sowing date of May 10th is the one optimum for IR 77510, IR 78530 and IR 71137. Generally aromatic varieties i.e. Egyptian Yasmin, IR77510-88-1-3-3, IR78530-45-3-1-3, IR 74052-177-3-3, IR 71137-51-2 and IR65610-38-2-4-2-6-3 could be recommended to be sown in April 24th and May 10th.

INTRODUCTION

Aromatic rice (scented rice) is one of the main objectives for breeding program in Egypt. Aromatic rice which cultivated mainly in Asia posses high quality and high and high price in comparison with the other rices. In Egypt, aromatic rice is cultivated in small area mainly for export to Arabian countries which prefer this type of rice, moreover, some local consumers prefer it also.

The potentiality of the varieties expressed differently due to planting in different dates (Ganajaxi *et al.* 2001). Also, optimum planting time is a major factor in rice cultivation and indirectly determines soil temperature and

weather conditions to which young seedling and rice plants are subjected to it during different developing stages (Ashrafuzzaman *et al.* 2009). Regarding weather conditions, high temperature, differences between days and night temperature, relative humidity during filling period play an important role to increase aromatic or scent level in the endosperm.

Early planted photoperiod sensitive rice varieties passed lag vegetative phase which increased tallness as well as biomass that tended to lodge during grain filling stage (Akhter *et al.* 2007)

Genetic diversity can reduce vulnerability to stresses and it constitutes the raw material for plant breeders. Relative divergence measures among accessions can be based on quantitative morphological traits. Genetic relationships among individuals and populations can be measured by similarity of number of quantitative characters (Souza and Sorrells (1991), Zhang *et al.* (1995), Dinghuhn and Asch (1999), Bahrman *et al.*, (1999) and El-Malky (2004). A better knowledge of the genetic behavior of some aromatic varieties under different sowing dates would help to classify and identify varieties that would be grown successfully under late sowing date.

The objective of the present investigation was to study the optimum planting date and genetic behavior of six aromatic rice varieties under four sowing dates using quantitative characters and asses the correlation coefficients among the studied characters.

MATERIALS AND METHODS

Two field experiments were carried out at the farm of the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Egypt, during 2008 and 2009 seasons, to study the performance of some promising aromatic rice varieties under early and late sowing dates. Six aromatic rice varieties namely; IR77510-88-1-3-3, IR78530-45-3-1-3, IR74052-177-3-3, IR71137-51-2 and IR65610-38-2-4-2-6-3 as well as the local variety Egyptian Yasmin were used in the two seasons Table(1). The selected varieties was drawn from introduced materials came from the International Rice Research Institute (IRRI), Los Baños, Philippines.

Table (1): Rice varieties, parentage, origin, type and grain shape.

Variety	Parentage	Origin	Type	Grain shape
Egyptian Yasmin	IR262-43-8-11/KDML105	Egypt	Indica	Long cylinder
IR77510-88-1-3-3	IR68726-3-1-2/IR71137-234-2-2-3-3	IRRI*	Indica	Long cylinder
IR78530-45-3-1-3	IR69745-251-2-2-1-1/IR71146-287-3-3-2-1	IRRI	Indica	Long cylinder
IR74052-177-3-3	IR44699-21-1-3-4/IR66438-167-3-3-2-3	IRRI	Indica	Long cylinder
IR71137-51-2	IR44699-21-1-3-4/IR66438-167-3-3-2-3	IRRI	Indica	Long cylinder
IR65610-38-2-4-2-6-3	IET10364/IR54950-181-2-1-2-3	IRRI	Indica	Long cylinder

***IRRI: International Rice Research Institute, Los Baños, Philippines**

Four dates of sowing, i.e. April 24th, May 10th, May 24th and June 10th were applied in 2008 and 2009 seasons. The six aromatic varieties were laid out in randomized complete block design with four replications in each sowing date in both seasons. A combined analysis was used among sowing dates in each season.

Monthly temperature and relative humidity are shown in Table (2) according to Sakha Meteorological Station.

Table (2): Monthly temperature and relative humidity at Rice Research & Training Center, Sakha, Kafr El-Sheikh province in 2008 and 2009 rice growing seasons.

Month	Temperature (°c)				Relative humidity (%)	
	2008		2009			
	Max.	Min.	Max.	Min.	2008	2009
April	27.8	8.3	27.0	11.0	58.0	62.5
May	29.0	10.0	28.7	12.6	56.5	58.8
June	33.0	15.0	33.6	19.0	66.2	62.5
July	32.0	15.7	33.0	20.2	67.8	65.3
August	33.0	16.3	32.4	19.0	69.6	66.3
September	33.5	15.0	32.5	19.0	62.5	61.5
October	28.0	11.0	30.3	16.2	60.0	61.8
November	26.0	8.0	26.0	10.5	67.5	63.9

The studied characters were leaf area index at 98 days after sowing (DAS), Dry matter accumulation (g m^{-2}) at 98 DAS, plant height (cm) at harvesting, number. of tillers m^{-2}, 1000 g weight, number of filled grains $panicle^{-1}$, number of panicles m^{-2}, straw yield (t ha^{-1}), grain yield (t ha^{-1}) and test of aroma.

Test of aroma, there are several ways of testing the aroma of rice varieties. The common one is : place 20-30 freshly harvested milled rice grains in a 40 ml test tube. Add 20 ml of distilled water, cover with aluminum foil, and place in a bolling water bath for 10 minutes (20 minutes for brown rice). Remove the test tube from the water bath and cool to room temperature. Rate the aroma of rice samples as strong (2), slight (1) and no aroma (0). This method was applied according to standard evaluation system for rice (SES) of IRRI, (1996).

A analysis of variance was carried out as a combined analysis for the four sowing dates in each season according to Gomez and Gomez (1984). Treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955). All statistical analysis was performed using analysis of variance technique by means of "MSTATC" computer software package. The analysis was conducted using the Numerical Taxonomy and Multivariate Analysis system, Version 2.1 (NTSYSpc; Rolhf, 2000). The output was analyzed using an agglomerative hierarchical clustering method with complete linkage strategy. Firstly, the data was subjected to analysis to produce a matrix of dissimilarity values and the phenotypic distance between each pair of varieties was estimated as Euclidean distance. Secondly, cluster analysis was then conducted on the Euclidean distance matrix with un-weighed pair-group method based on arithmetic average (UPGMA) to develop a dendogram.

RESULTS AND DISCUSSION

1- Vegetative characters:

1-1- Leaf area index

Table (3) showed that leaf area index of aromatic rice at 98 days after sowing (DAS) was significantly affected by sowing date, genotype and their interaction in 2008 and 2009 seasons. Maximum leaf area index was produced by all varieties sown in May 10th which was statistically at par with that in April 24th in the two seasons. Delay sowing date than May 10th resulted in a significant decrease in leaf area index in the two seasons. Minimum leaf area index was recorded at the late sowing date (June 10th) in both seasons. The increase in leaf area index at early sowing date is caused by an increase in tiller number or leaves on each tiller and in size of successive leaves. These differences between the sowing dates were probably related to differences in weather conditions. These findings agreed with Sahu (1994) and Nayak *et al.* (2003).

Aromatic rice varieties exhibited significant differences in leaf area index in the two seasons. The rice variety Egyptian Yasmin and IR77510 were among those which having the highest leaf area index. The variety IR65610 produced the lowest leaf area index in both seasons. The superiority of Egyptian Yasmin and IR77510 varieties in leaf area index could be attributed to high number of tillers and leaves. The genotype differences in leaf area index, as here obtained, reflect different genetic make up or genetic constitution. Varietal differences of leaf area index were reported by Ghosh *et al.* (2004).

Table (3): leaf area index and dry matter accumulation of some aromatic rice varieties at 98 DAS as affected by different sowing dates in 2008 and 2009 rice seasons.

Factors	Leaf Area Index		Dry matter accumulation (g m^{-2})	
	2008	2009	2008	2009
Sowing date:	*	**	**	**
April 24th	5.45ab	5.60ab	1033a	1168ab
May 10th	5.86a	6.07a	1084a	1238a
May 24th	5.18b	5.30b	991ab	1099b
June 10th	4.64c	4.65c	908b	968c
Variety:	*	**	**	*
E.Yasmin	5.507ab	5.655a	1039a	1175a
IR77510	5.620a	5.577ab	1053a	1159ab
IR78530	5.200c	5.515abc	991b	1142ab
IR74052	5.115c	5.403bc	984b	1127b
IR71137	5.262bc	5.352c	996b	1085c
IR65610	4.997c	4.925d	962c	1022d
Interaction	*	**	**	NS

***, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.**

The interaction between sowing date and aromatic rice varieties had a significant effect on Leaf area index in the two seasons. Data in Table (4) show that the greatest Leaf area index were produced by the variety

IR77510 sown in May 10th which was statistically the same to Egyptian Yasmin, IR78530 and IR 71137 sown on the same date in both seasons. The lowest leaf area index was obtained by sowing IR 65610 variety on the late date (June 10th) in the two seasons. Generally, delaying sowing date decreased leaf area index of all studied varieties in the two seasons. These results in agreement with those reported by Ghosh *et al.* (2004)

Table (4): Leaf area index at 98 days after sowing as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	5.660 cde	6.060 ab	5.330 efgh	4.980 hi
IR77510	5.770 bcd	6.160 a	5.570 cde	4.980 hi
IR78530	5.160 fghi	5.850 abc	5.200 fghi	4.590 jk
IR74052	5.420 defg	5.650 cde	4.970 hi	4.420 k
IR71137	5.530 cdef	5.810 abc	5.140 ghi	4.570 jk
IR65610	5.170 fghi	5.640 cde	4.880 ij	4.300 k
2009 Season				
E.Yasmin	6.230 a	6.190 a	5.450 cde	4.750 fgh
IR77510	5.940 ab	6.280 a	5.360 cde	4.730 fgh
IR78530	5.980 a	6.290 a	5.240 de	4.550 gh
IR74052	5.620 bc	6.020 a	5.330 cde	4.640 gh
IR71137	4.730 fgh	6.300 a	5.560 cd	4.820 fg
IR65610	5.090 ef	5.360 cde	4.830 fg	4.420 h

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-2- Dry matter accumulation:

Dry matter accumulation (g m^{-2}) of aromatic rice at 98 DAS as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (3). Sowing date had a significant effect on dry matter accumulation (g m^{-2}) in the two seasons. Rice plants sown on the second date (May 10th) significantly accumulated greater dry matter than those sown on the May 24th and June 10th in the two seasons. Such effect of the early sowing might have been resulted from increased photosynthetic area (leaf area), which resulted in more photosynthetic production and consequently increased dry matter accumulation. These findings are true in both seasons and in close agreement with those reported by Vandana *et al.* (1994), Reddy and Reddy (1994), Nayak *et al.* (2003) and Latif (2005).

Aromatic rice varieties varied significantly in dry matter accumulation (g m^{-2}) in the two seasons. Plants of the IR77510 variety and Egyptian Yasmin significantly accumulated the greatest dry matter (g m^{-2}) in the two seasons. Plants of IR 65610 variety produced the lowest dry matter accumulation (g m^{-2}) in the two seasons. The superiority of the IR77510 variety and Egyptian Yasmin might have been resulted from increased photosynthetic area (leaf area), which resulted in more photosynthate production and consequently increased dry matter accumulation. Varietal differences of dry matter accumulation were reported by Vandana *et al.* (1994).

The interaction between sowing date and aromatic rice varieties had a significant effect on dry matter accumulation (g m^{-2}) at 98 DAS in the first season, (Table 5). The greatest dry matter accumulation (g m^{-2}) was obtained by sowing Egyptian Yasmin variety and IR77510 variety in April 24th or May 10th. The lowest dry matter accumulation (g m^{-2}) was obtained by sowing of IR 65610-38-2-4-2-6-3 variety on the late date of sowing. No marked differences of interaction between rice varieties and sowing dates were recorded in the second season.

Table (5): Dry matter accumulation (g m^{-2}) of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 season.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
E. Yasmin	1072 ab	1124 a	1007 cde	952 ef
IR77510	1078 ab	1127 a	1046 bcd	962 ef
IR78530	990 de	1078 ab	992 de	905 fg
IR74052	1035 bcd	1067 abc	964 ef	870 g
IR71137	1037 bcd	1051 bcd	990 de	906 fg
IR65610	989 de	1057 bc	945 ef	856 g

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-3- Plant height :

Plant height of aromatic rice at harvest as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (6). Sowing date significantly influenced plant height in the two seasons. Rice plants which sown on the two early dates April 24th or May 10th were taller than those sown on the two late dates May 24th or June 10th in the two seasons. Delay sowing date decreased plant height in the two seasons. These findings are in close agreement with those reported by Dixit *et al.* (2004), Akhter *et al.* (2007) and Ashrafuzzaman *et al.* (2009).

Table (6): Plant height (cm) and number of tillers m^{-2} of some aromatic rice varieties at harvest as affected by different sowing dates in 2008 and 2009 rice seasons.

Factors	Plant height (cm)		No. of tillers m^{-2}	
	2008	2009	2008	2009
Sowing date:	*	*	**	*
April 24th	117.8a	109.4a	413c	435b
May 10th	112.3a	109.1a	516a	534a
May 24th	99.70b	94.90b	472ab	487a
June 10th	93.40c	87.30c	432bc	413b
Variety:	*	*	**	**
E.Yasmin	102.7b	93.30c	488ab	462bc
IR77510	101.8b	99.10bc	499a	487ab
IR78530	109.9a	101.6b	470b	496a
IR74052	109.9a	108.6a	427c	458bc
IR71137	112.3a	103.2ab	441c	435c
IR65610	98.20b	95.30c	425c	466abc
Interaction	**	*	**	*

***, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.**

Aromatic rice varieties revealed a significant difference on plant height in the two seasons. Plants of IR74.52 variety recorded the tallest height in the two seasons. Plants of IR 65610variety recorded the lowest ones in the two seasons.

The interaction between sowing date and aromatic rice varieties had a significant effect on plant height in the two seasons.(Table 7). The tallest plants were obtained by sowing IR74052 and IR71137 varieties on the early date in the two seasons. The shortest plant was obtained by sowing IR 65610 variety on the first date in the second season.

Table (7): Plant height (cm) as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	113.0 cde	110.0 defg	94.00 i	93.90 i
IR77510	112.1 cdef	103.2 gh	98.10 hi	93.70 i
IR78530	111.2 cdef	119.7 b	105.3 fg	103.4 gh
IR74052	134.8 a	117.2 bc	94.40 i	93.30 i
IR71137	129.2 a	115.2 bcd	112.2 cdef	92.50 i
IR65610	106.6 efg	108.3 defg	94.40 i	83.50 J
2009 Season				
E.Yasmin	105.7 def	101.7 fg	90.10 h	75.60 i
IR77510	110.6 bcd	102.8 ef	94.30 h	88.70 h
IR78530	109.7 b-e	106.5 c-f	95.50 gh	94.70 h
IR74052	116.4 ab	119.1 a	104.4 def	94.50 h
IR71137	112.7 abc	116.2 ab	94.60 h	89.50 h
IR65610	101.2 fg	108.2 cdef	90.70 h	80.80 i

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-4- Number of tillers m^{-2}:

Tillers numbers m^{-2} of aromatic rice at harvest as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (6). Sowing date substantially influenced tillers numbers m^{-2} at dates in the two seasons. Rice plants sown on the second or third dates produced greater tillers numbers m^{-2} than those sown on early and late dates in the two seasons. These finding are supported by the work done by Aslam (2000), Dixit *et al.* (2004), Akram *et al.* (2007), Shahidullah *at al.* (2009) and Mannan *et al.* (2009).

Aromatic rice varieties significantly varied in tillers numbers m^{-2} in the two seasons. Plants of IR77510 variety produced the greatest tillers numbers m^{-2} at harvest in the two seasons. Plants of IR 65610 and IR 71137 varieties produced the lowest tillers numbers m^{-2} in the first and second seasons, respectively.

The interaction between sowing date and aromatic rice varieties had a significant effect on tillers numbers m^{-2} in the two seasons (Table 8). The greatest tillers numbers m^{-2} was obtained by sowing IR77510 variety on the second date in the two seasons. The lowest tillers numbers m^{-2} were obtained by sowing IR65610 variety on the late date in the two seasons.

Table (8): Number of tillers m^{-2} of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	451.0 f-J	526.0 a-d	491.0 b-g	482.0 c-h
IR77510	436.0 g-k	556.0 a	542.0 ab	463.0 e-i
IR78530	396.0 Jk	536.0 abc	510.0 a-e	438.0 g-k
IR74052	398.0 Jk	474.0 d-i	437.0 g-k	399.0 Jk
IR71137	405.0 Jk	503.0 a-f	428.0 h-k	427.0 h-k
IR65610	391.0 k	500.0 b-f	424.0 iJk	385.0 k
2009 Season				
E.Yasmin	488.0 d-g	518.0 a-e	460.0 f-i	382.0 k
IR77510	463.0 e-i	541.0 a-d	514.0 a-f	429.0 h-k
IR78530	511.0 a-f	558.0 a	504.0 a-f	412.0 iJk
IR74052	393.0 Jk	544.0 abc	490.0 c-g	403.0 Jk
IR71137	314.0 l	546.0 ab	474.0 e-h	405.0 Jk
IR65610	442.0 g-J	495.0 b-g	483.0 e-h	445.0 g-J

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-5- 1000 – grain weight (g):

1000-grain weight of aromatic rice as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (9). Sowing date substantially influenced 1000-grain weight in the two seasons. Rice plants sown in April 24th and May 10th significantly produced heavier 1000-grain weight than those sown in June 24th in the two seasons. Delay sowing date significantly decreased 1000-grain weight in the two seasons. Such effect of the early date might have been resulted from increased photosynthetic area (leaf area), which resulted in more photosynthetic production and consequently increased dry matter accumulation and grain felling. Similar trend was found by Lu-Kaiyang and Cai-Mingli (2000), Singh *et al.* (2004), Shah and Kaliash (2005), Akram *et al.* (2007) and Nahar *et al.* (2009).

Aromatic rice varieties exhibited significant differences in 1000-grain weight in the two seasons. The relative ranking of varieties with respect to 1000-grain weight was inconsistent in the two seasons. The Egyptian Yasmin variety and IR 65610 and IR 78530 varieties were among those having the heaviest 1000-grain weight in both seasons. Mondal *et al.* (2005) studied 17 modern cultivars of transplanted rice and reported that 1000-grain weight differed significantly among the studied cultivars, which supported the present study results.

The interaction between sowing date and aromatic rice varieties had a significant effect on 1000-grain weight in the two seasons (Table 10). The relative ranking of interaction with respect to 1000-grain weight was inconsistent in the two seasons. The Egyptian Yasmin, IR 78530 and IR 65610 varieties sown on 24th April or 10th May were among those having the heaviest 1000-grain weight in both seasons. Also, IR 77510 and IR 71137 varieties sown in May 10th did not differ from the mentioned varieties in this respect in the two seasons.

Table (9): 1000 g weight, No. of filled grains panicle^{-1} and No. of panicles m^{-2} of some aromatic rice varieties as affected by sowing dates in 2008 and 2009 seasons.

Factors	1000 g weight		No of filled grains panicle^{-1}		No. of Panicles m^{-2}	
	2008	2009	2008	2009	2008	2009
Sowing date:	**	*	**	**	**	**
April 24th	24.064a	23.989a	145a	144a	406b	420b
May 10th	24.080a	24.211a	134ab	130ab	507a	514a
May 24th	23.532b	23.213b	117bc	123bc	468a	472a
June 10th	21.618b	21.929c	101c	113c	417b	400b
Variety :	*	*	**	**	**	*
E.Yasmin	24.00a	23.87a	141a	147a	482a	441bc
IR77510	23.10bc	23.16ab	134ab	117b	489a	471ab
IR78530	23.92a	23.76a	120c	129b	462ab	484a
IR74052	22.52c	22.83 b	121c	129b	419c	441bc
IR71137	22.75c	23.12ab	130bc	127b	429bc	420c
IR65610	23.64ab	23.27ab	100d	117b	416c	452bc
Interaction	*	*	*	*	**	*

***, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test**

Table (10): 1000-grain weight (g) of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	24.99 a	24.19 a-d	24.05 a-e	22.79 fg
IR77510	23.23 c-g	23.92 a-f	23.88 a-f	21.39 h
IR78530	24.88 ab	24.35 abc	23.82 b-f	22.64 g
IR74052	23.47 c-g	22.96 efg	22.86 fg	20.80 h
IR71137	23.03 efg	24.25 a-d	23.13 d-g	20.59 h
IR65610	24.79 ab	24.82 ab	23.45 cd-g	21.51 h
2009 Season				
E.Yasmin	24.32 a-d	23.94 a-d	24.39 abc	22.82 efg
IR77510	21.60 hiJ	24.73 a	24.34 a-d	21.98 ghi
IR78530	25.01 a	24.25 a-d	22.47 fgh	23.31 cdef
IR74052	24.05 a-d	23.24 def	23.31 cdef	20.70 J
IR71137	24.53 ab	24.60 ab	21.19 iJ	22.17 ghi
IR65610	24.43 ab	24.50 ab	23.58 b-e	20.59 J

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-6- Number of filled grains per panicle:

Number of filled grains per panicle of aromatic rice as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (9). Sowing date substantially influenced number of filled grains per panicle in the two seasons. Rice plants sown on the first and second dates significantly produced greater number of filled grains per panicle than those sown on the late date in the two seasons. These finding are supported by the work done by Mahmood *et al.* (1995), Singh *et al.* (2004), Shah and Bhurer (2005) and Nahar *et al.* (2009).

Aromatic rice varieties significantly varied in number of filled grains per panicle in the two seasons. Plants of IR77510 variety produced the highest number of filled grains per panicle at harvest in the two seasons. Plants of IR 65610 variety produced the lowest number of filled grains per panicle in the first and second seasons, respectively.

The interaction between sowing date and aromatic rice varieties had a significant effect on number of filled grains per panicle in the two seasons (Table 11). The greatest number of grains per panicle was obtained by sowing Egyptian Yasmin variety on the April 24th in the two seasons. The lowest number of filled grains per panicle were obtained by sowing IR 65610 variety on the late date in the two seasons.

Table (11): No. of filled grains panicle^{-1} of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	161.0 a	151.0 abc	129.0 defg	121.0 fghi
IR77510	154.0 ab	143.0 bcd	131.0 def	109.0 hiJk
IR78530	137.0 cde	126.0 efg	120.0 f-iJ	97.00 kl
IR74052	138.0 cde	125.0 efg	115.0 ghiJ	107.0 iJk
IR71137	151.0 abc	139.0 cde	122.0 fgh	106.0 Jk
IR65610	129.0 defg	118.0 f-J	85.00 l	66.00 m
2009 Season				
E.Yasmin	161.0 a	146.0 bc	148.0 bc	133.0 d-h
IR77510	140.0 cde	112.0 kl	109.0 l	105.0 l
IR78530	142.0 cd	126.0 ghiJ	124.0 hiJ	123.0 iJ
IR74052	151.0 b	133.0 d-h	119.0 Jk	112.0 kl
IR71137	134.0 defg	129.0 fghi	132.0 e-i	113.0 kl
IR65610	137.0 def	134.0 defg	107.0 l	89.00 m

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-7- Number of panicle m^{-2}:

Panicle number m^{-2} of aromatic rice as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (9). Sowing date substantially influenced panicle number m^{-2} in the two seasons. Rice plants sown on the second or third dates significantly produced greater panicle number m^{-2} than those sown on early and late dates in the two seasons. These findings are consistent with those reported by Lee and Jun (1998), Ganajaxi *et al.* (2001), Linscombe *et al.* (2004), Singh *et al.* (2004), Nahar *et al.* (2009) and Mannan *et al.* (2009).

Aromatic rice varieties significantly varied in panicle number m^{-2} in the two seasons. Plants of IR77510 variety markedly produced the highest panicle number m^{-2} at harvest in the two seasons. Plants of IR 65610 and IR 71137 varieties produced the lowest panicle number m^{-2} in the first and second seasons, respectively. The increase in panicle number m^{-2} may be due to increase in tillers number m^{-2}.

The interaction between sowing date and aromatic rice varieties had a significant effect on panicle number m^{-2} in the two seasons.(Table 12). The

greatest panicle number m^{-2} was obtained by sowing IR77510 variety on the second date in the two seasons. The lowest panicle number m^{-2} were obtained by sowing IR 65610 and Egyptian Yasmin varieties on the late date in the first and second seasons, respectively.

Table (12): No. of panicle m^2 of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	439.0 ghi	523.0 abc	489.0 cde	476.0 defg
IR77510	431.0 hiJ	550.0 a	531.0 ab	443.0 fghi
IR78530	393.0 Jkl	532.0 ab	506.0 bcd	418.0 iJk
IR74052	392.0 Jkl	464.0 efgh	435.0 hi	386.0 kl
IR71137	395.0 Jkl	490.0 cde	426.0 hiJk	407.0 iJkl
IR65610	389.0 kl	480.0 def	422.0 iJk	371.0 l
2009 Season				
E.Yasmin	470.0 defg	496.0 bcd	434.0 fghi	363.0 l
IR77510	446.0 e-h	521.0 abc	503.0 a-d	415.0 h-k
IR78530	501.0 a-d	545.0 a	489.0 b-e	399.0 iJkl
IR74052	373.0 kl	525.0 ab	477.0 cdef	388.0 Jkl
IR71137	302.0 m	520.0 abc	465.0 defg	393.0 iJkl
IR65610	426.0 ghiJ	479.0 cdef	461.0 defg	443.0 fgh

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-8- Straw yield (t ha^{-1}):

Straw yield of aromatic rice as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented in Table (13). Sowing date substantially influenced straw yield in the two seasons. Rice plants sown in April 24th and May 10th markedly produced higher straw yield than those sown on the late date in both season. Delay sowing date decreased straw yield in the two seasons. Thus, the two early sowing date increased straw yield through increasing number of tillers m^{-2} and plant height. Moreover, growth in terms of leaf area index, dry matter accumulation and crop growth rate were in favour of the early dates and in turn increased different straw yield. Aslam (2000) and Islam *et al.* (2008) reported similar trend.

Aromatic rice varieties exerted a significant effect on straw yield in the two seasons. Plants of Egyptian Yasmin and IR 77510 in markedly produced the highest straw yield in the two seasons. Plants of IR65610 variety produced the lowest straw yield in the two seasons. The superiority of Egyptian Yasmin and IR 77510 variety might resulted from its better growth. Ashrafuzzaman *et al.* (2009) indicated that six aromatic rice varieties differed significantly to straw yield.

Table (13): Straw yield and grain yield and of some aromatic rice varieties as affected by sowing dates in 2008 and 2009 seasons.

Factor	Straw yield (t ha^{-1})		Grain yield (t ha^{-1})	
	2008	2009	2008	2009
Sowing date:	**	*	**	**
April 24th	12.388 a	12.092 a	7.295 a	7.984 b
May 10th	12.279 a	11.362 a	7.689 a	9.021 a
May 24th	11.909 a	9.862 b	5.911 b	7.384 c
June 10th	9.977 b	9.507 b	5.411 b	6.019 d
Variety :	*	*	**	*
E.Yasmin	11.79 ab	11.23 a	7.134 a	9.180 a
IR77510	12.72 a	10.93 a	7.067 ab	8.019 b
IR78530	10.71 b	11.18 a	6.259 c	7.103 bc
IR74052	11.60 b	11.38 a	6.183 c	6.921 bc
IR71137	11.75 ab	11.06 a	6.483 bc	7.644 bc
IR65610	11.26 b	8.466 b	6.334 c	6.747 c
Interaction	*	*	**	**

***, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively. Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.**

The interaction between sowing date and aromatic rice varieties had a significant effect on straw yield in the two seasons (Table 14). The highest straw yield was obtained by sowing Egyptian Yasmin variety and IR 77510 varieties sown in April 24th and May 10th during the two seasons. Delay sowing date decreased straw yield of all varieties in the two seasons.

Table (14): Straw yield (t ha^{-1}) of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	12.91 abc	12.25 abc	11.95 a-d	10.04 e-h
IR77510	13.31 a	13.16 ab	12.90 abc	11.50 a-e
IR78530	11.15 cdef	11.05 c-g	11.30 b-f	9.341 gh
IR74052	12.56 abc	12.81 abc	11.95 a-d	9.090 h
IR71137	12.45 abc	12.25 abc	11.95 a-d	10.35 d-h
IR65610	11.95 a-d	12.15 a-d	11.40 b-e	9.542 fgh
2009 Season				
E.Yasmin	13.03 ab	11.83 b-e	10.14 d-h	9.894 e-i
IR77510	12.90 ab	12.30 abc	9.023 ghi	9.499 fghi
IR78530	13.97 a	12.48 abc	9.326 ghi	8.930 ghi
IR74052	13.34 ab	11.49 b-f	10.58 c-g	10.11 d-i
IR71137	10.02 d-i	11.69 b-e	11.98 bcd	10.54 c-g
IR65610	9.289 ghi	8.376 hi	8.128 hi	8.069 i

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-9- Grain yield (t ha^{-1}):

Grain yield is the final indicator of crop behavior under different crop management practices. Grain yield of aromatic rice as affected by sowing date, genotype and their interaction in 2008 and 2009 seasons are presented

in Table (13). Sowing date substantially influenced grain yield in the two seasons. Rice plants sown in May 10th significantly out yielded those sown on the other dates in both season, except the early date April 24th in the first season. Delay sowing date decreased grain yield in the two seasons. Thus, the two early sowing date increased grain yield through increasing number of panicles m^{-2} and 1000-grains weight. Moreover, growth in terms of leaf area index, dry matter accumulation and crop growth rate were in favour of the early dates and in turn increased different yield attributes. Similar conclusion was previously drawn by Nayak *et al.* (2003), Verma *et al.* (2004), Shah and Kaliash (2005), Habibullah *et al.* (2007), Hossain *et al.* (2008), Safdar *et al.* (2008) and Nahar *et. al* (2009).

Aromatic rice varieties exerted a significant effect on grain yield in the two seasons. Plants of Egyptian Yasmin in the two seasons and IR 77510 in the first season significantly produced the greatest grain yield. Plants of IR 65610 variety produced the lowest grain yield in the two seasons. The superiority of Egyptian Yasmin and IR 77510 variety might resulted from its better growth, i.e. leaf area index, dry matter accumulation and yield attributes, i.e. number of panicles m^{-2} and number of filled grain panicle^{-1}. Ganajaxi *et al.* (2001), Ghosh *et al.* (2004) Ashrafuzzaman *et al.* (2009), Mannan *et al.* (2009) and Shahidullah *et al.* (2009) reported similar results for aromatic rice genotypic variations for grain yield.

The interaction between sowing date and aromatic rice varieties had a significant effect on grain yield in the two seasons (Table 15). The highest grain yield was obtained by sowing Egyptian Yasmin variety, IR 77510, IR 78530 and IR 71137 varieties on 10th May in the two seasons. The Egyptian Yasmin variety sown on April 24th or May 10th produced the same grain yield in the two seasons. Delay sowing date decreased grain yield of all varieties in the two seasons.

Table (15): Grain yield (t ha^{-1}) of some aromatic rice varieties as affected by the interaction between sowing date and genotype in 2008 and 2009 seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
2008 Season				
E.Yasmin	7.600 a-d	8.467 a	6.467 efgh	6.000 ghiJ
IR77510	8.133 abc	8.267 ab	6.133 fghi	5.733 hiJ
IR78530	7.102 cdef	7.533 a-d	5.400 iJ	5.000 J
IR74052	6.600 d-h	7.000 defg	5.733 hiJ	5.400 iJ
IR71137	7.333 b-e	7.600 a-d	5.933 hiJ	5.067 iJ
IR65610	7.000 d-g	7.267 b-e	5.800 hiJ	5.267 iJ
2009 Season				
E.Yasmin	9.900 ab	10.11 a	9.056 abc	7.651 d-i
IR77510	8.653 b-e	9.639 ab	7.722 c-h	6.061 Jk
IR78530	6.961 f-J	8.911 a-d	7.028 f-J	5.510 k
IR74052	7.858 c-g	7.917 c-f	6.500 g-k	5.410 k
IR71137	7.133 f-J	9.539 ab	7.611 d-i	6.294 iJk
IR65610	7.400 e-J	8.011 cdef	6.389 hiJk	5.187 k

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's Multiple Range Test.

1-10- Test of aroma:

According to aroma test, the date in table (16) showed that Egyptian Yasmin variety was strong in aroma in April 24th and May 24th, while it decreasing in late sowing dates (May 24th and June 10th). On the other hand, IR77510-88-1-3-3 and IR78530-45-3-1-3 were the same trend in early and late sowing dates. IR74052-177-3-3 and IR65610-38-2-4-2-6-3 were not affected by early and late sowing dates. Finally, IR71137-51-2 variety was strongly scented in optimum sowing dates. The conclusion that May 10th was the optimum sowing date of rice under Egyptian condition and the scented aromatic was strongly in optimum sowing, while the early and late sowing it will be decreasing in this characters Table (16). This due to the differences in temperature between day and night during filling period Table2 (16.7Co and 13.4 Co in 2008 and 2009 respectively) as well as relative humidity 69.6 and 66.3 in 2008 and 2009 respectively.

Table (16): Aromatic evaluation (reaction) for the tested varieties under different dates of sowing during the two seasons.

Variety	Sowing date			
	April 24th	May 10th	May 24th	June 10th
	Scent score			
E.Yasmin	2	2	1	1
IR77510	1	2	1	1
IR78530	1	2	1	1
IR74052	1	1	1	1
IR71137	1	2	1	1
IR65610	1	1	1	1

Score: 0 = None scented, 1 = Slightly scented, 2 = Strong scented

2-Mean performance:

2-1- Under first sowing date (April 24th)

Results in Table (17) showed that Egyptian Yasmin and IR77510 were high in grain yield (8.75 and 8.39 t ha^{-1}). These varieties had also high in straw yield and number of field grain per panicles and produced more dry matter per m^2 and LAI.

Table (17): Mean performance and variance for six varieties under first sowing date (Average of two years).

Variety	L.A.I	D. M.	P. H.	No.T.	S.Y.	G.Y.	1000g	No.G.	No.P.
E.Yasmin	5.945	911.5	109.5	469.5	12.97	8.75	34.65	161.0	454.5
IR77510	5.855	897.0	111.4	449.5	13.1	8.39	22.41	147.0	438.5
IR78530	5.570	855.0	110.5	453.5	12.56	7.03	24.94	139.5	447.0
IR74052	5.520	857.5	126.5	395.5	12.95	7.22	23.76	144.5	382.5
IR71137	5.130	805.0	121.0	359.5	11.23	7.23	23.78	142.5	348.5
IR65610	5.130	800.5	104.0	416.5	10.61	7.20	24.61	133.0	704.5
Std. Dev.	1.904	45.67	8.29	41.52	1.05	0.74	4.48	9.38	125.6
Variance	4.692	854.5	113.8	424.0	12.24	7.64	25.69	144.6	462.6

L.A.I: Leaf Area Index D.M.: Dry matter accumulation g m^{-2} P.H.: Plant height cm
No. T.: Number of tillers m^{-2} S.Y.: Straw yield t ha-1 G.Y.: Grain yield t ha^{-1}
1000g: 1000 grain weight g No.G.: Number of filled grains $panicle^{-1}$
No.P.: Number of panicle m^2

2-2- Under second sowing date (May 10th)

Data in Table (18) show that grain yield ranged from 7.45 t ha^{-1} to 9.28 t ha^{-1}, where Egyptian Yasmin produced the highest grain yield followed by IR77510, IR71137 and IR78530 respectively. Also, these varieties were superior in L.A.I , dry matter (g m^{-2}), number of tillers m^{-2}, number. of grains/panicle and number of panicles m^{-2}. Such difference could be attributed to genetic variability among rice varieties under study.

Table (18): Mean performance and variance for seven varieties under second sowing date (Average of two years).

Variety	L.A.I	D. M.	P. H.	No.T.	S.Y.	G.Y.	1000g	No.G.	No.P.
E.Yasmin	6.12	934.5	105.9	522.0	12.04	9.28	24.06	148.5	509.5
IR77510	6.22	940.5	103.0	548.5	12.73	8.95	24.32	127.5	535.5
IR78530	6.07	916.5	113.1	547.0	11.76	8.22	24.3	126.0	538.5
IR74052	5.83	895.0	118.2	509.0	12.15	7.45	23.10	129.0	494.5
IR71137	6.05	904.0	115.7	524.5	11.97	8.56	24.42	134.0	505.0
IR65610	5.50	849.0	108.3	497.5	10.26	7.63	24.66	126.0	479.5
Std. Dev.	0.26	22.12	5.92	20.29	0.83	0.72	0.55	8.69	23.05
Variance	5.97	906.6	110.7	524.7	11.82	8.35	24.14	131.8	510.4

L.A.I: Leaf Area Index D.M.: Dry matter accumulation g m^{-2}
P.H.: Plant height cm No. T.: Number of tillers m^{-2} S.Y.: Straw yield t ha-1
G.Y.: Grain yield t ha^{-1}
1000g: 1000 grain weight g No.G.: Number of filled grains panicle^{-1}
No.P.: Number of panicle m^{2}

2-3- Under third sowing date (May 24th)

Results in Table (19) show that grain yield ranged from 6.09 t ha^{-1} to 7.76 t ha^{-1} and the highest values t ha^{-1} (7.76, 6.92 and 6.77 t ha^{-1}) were recorded with Egyptian Yasmin, IR77510 and IR71137, respectively. High yield of these varieties is attributed to high values of dry matters (g m^{-2}), leaf area index and number of tillers m^{-2}.

Table (19): Mean performance and variance for seven varieties under third sowing date (Average of two years).

Variety	L.A.I	D. M.	P. H.	No.T.	S.Y.	G.Y.	1000g	No.G.	No.P.
E.Yasmin	5.39	831.0	92.1	475.5	11.04	7.76	24.22	138.5	461.5
IR77510	5.46	843.5	96.2	528.5	10.96	6.92	24.11	120.0	517.0
IR78530	5.22	809.5	100.4	507.0	10.31	6.21	23.14	122.0	497.5
IR74052	5.15	801.5	99.4	463.5	11.26	6.11	23.08	117.0	456.0
IR71137	5.35	829.5	103.4	451.0	11.96	6.77	22.16	127.0	445.5
IR65610	4.85	761.0	92.6	453.5	9.76	6.09	23.51	96.0	441.5
Std. Dev.	0.22	29.58	4.53	31.36	0.77	0.65	0.76	14.00	30.48
Variance	5.24	812.7	97.33	479.8	10.89	6.64	23.37	120.1	469.8

L.A.I: Leaf Area Index D.M.: Dry matter accumulation g m^{-2} P.H.: Plant height cm
No. T.: Number of tillers m^{-2} S.Y.: Straw yield t ha-1 G.Y.: Grain yield t ha^{-1}
1000g: 1000 grain weight g No.G.: Number of filled grains panicle^{-1}
No.P.: Number of panicle m^{2}

2-4- Under fourth sowing date (June 10th)

The results in Table (20) revealed that grain yield t ha^{-1} ranged from 5.22 t ha^{-1} t ha^{-1} to 6.82 t ha^{-1} and the highest values (6.82, 5.89 and 5.68 t ha^{-1}) were recorded with Egyptian Yasmin, IR77510 and IR71137,

respectively. Generally, late sowing dates were effected reduction for all characters of rice varieties under this study.

Table (20): Mean performance and variance for seven varieties under fourth sowing date (Average of two years).

Variety	L.A.I	D. M.	P. H.	No.T.	S.Y.	G.Y.	1000g	No.G.	No.P.
E.Yasmin	4.86	762.5	84.8	432	9.96	6.82	22.80	127.0	419.5
IR77510	4.85	765.0	91.2	446	10.49	5.89	21.68	107.0	429.0
IR78530	4.57	725.5	99.1	425	9.13	5.25	22.97	110.0	408.5
IR74052	4.53	714.0	93.9	401	9.60	5.40	20.75	109.5	387.0
IR71137	4.69	743.0	91.0	416	10.44	5.68	21.38	109.5	400.0
IR65610	4.36	692.0	82.2	415	8.80	5.22	21.05	77.5	407.0
Std. Dev.	0.20	28.60	6.13	15.55	0.69	0.60	0.92	16.07	14.68
Variance	4.64	733.7	90.34	422.5	9.74	5.71	21.77	106.8	408.5

L.A.I: Leaf Area Index D.M.: Dry matter accumulation g m^{-2} P.H.: Plant height cm
No. T.: Number of tillers m^{-2} S.Y.: Straw yield t ha-1 G.Y.: Grain yield t ha^{-1}
1000g: 1000 grain weight g No.G.: Number of filled grains $panicle^{-1}$
No.P.: Number of panicle m^2

3- Yield Reduction (t ha^{-1})

Data in Table (21) indicate that grain yield reduction under May 24th ranged from 1.34 to 2.03 (t ha^{-1}) . On the other hand, yield reduction under June 10th ranged from 2.05 to 3.06 (t ha^{-1}). Egyptian Yasmin varieties less achieving yield reduction, while IR77510 and IR78530 were mach recorded yield reduction under May 24th and June 10th. The results revealed that Egyptian Yasmin varieties is not effected by late sowing dates and consider from non photosensitive varieties. While, IR77510 and IR78530 were effected by late sowing dates and consider from photosensitive varieties.

Table (21): Grain yield and yield reduction t ha^{-1} of rice varieties as affected by different sowing dates in the two seasons.

Variety	Yield (t ha^{-1})				Yield Reduction (t ha^{-1})		
	April 24th	May 10th	May 24th	June 10th	April 24th	May 24th	June 10th
Egyptian Yasmin	8.75	9.29	7.76	6.83	0.54	1.53	2.46
IR77510	8.39	8.95	6.93	5.90	0.65	2.03	3.06
IR78530	7.03	8.22	6.21	5.26	1.19	2.01	2.97
IR74052	7.23	7.46	6.12	5.41	0.23	1.34	2.05
IR71137	7.23	8.57	6.77	5.68	1.34	1.80	2.89
IR65610	7.20	7.64	6.09	5.23	0.44	1.54	2.41

4-Clustering of the varieties based on similarity of agronomic characters:

4-1- At first sowing dates (April 24th):

Clustering of varieties based on their performance at first dates produced two large groups of varieties; the first group included IR65610, IR71137 and IR 74052 which were the similar in grain yield and LAI (Fig.1). Meanwhile, the second group included Egyptian Yasmin, IR77510 and IR78510, which were the same in plant height, number of tillers m^{-2} and number of panicle m^{-2}.

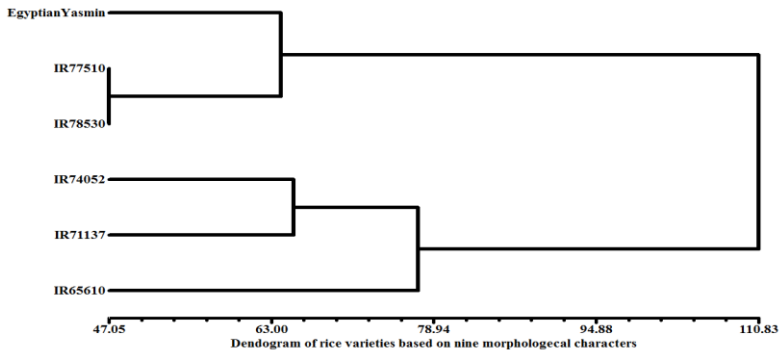

Fig.1. Cluster diagram for six rice varieties classified by nine morphological quantitative characters under first sowing dates (April 24th).

4-2- Under second sowing dates (May 10th):

Clustering of varieties based on second sowing dater performance generated two groups (Fig. 2). The first one included IR65610 only, which was leas one in LAI, number of tillers/m2 and number of panicle /m2. While, the second large group was included Egyptian Yasmin, IR74052, IR71137, IR77510 and IR78530. This group was divided into two sub-groups; the first one included IR77510 and IR78530 varieties together because of their similarity in LAI, dry matter, number of tillers m^{-2}, 1000- grain weight, number of filled grains per panicle and number of panicles m^{-2}. While, the second sub-group included Egyptian Yasmin in branch alone, which was higher one in grain yield and number of filled grain per panicle. The second branch included IR74052 and 71137 varieties together because of their similarity in plant height character (Fig. 2).

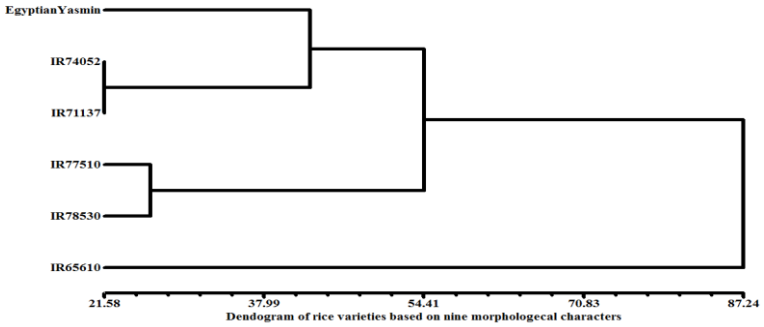

Fig.2. Cluster diagram for six rice varieties classified by nine morphological quantitative characters under second sowing dates (May 10th).

4-3- Under third sowing date (24th May):

Fig. 3 shows that clustering of six classified into two groups, the first one included IR77510 and IR78530 were in the same trend in number of

tillers m^{-2} and number of panicles m^{-2}. While, the second group included Egyptian Yasmin, IR71137, IR74052 and IR65610. This group divided into two sub-group, IR65610 in one branch alone because it had less one in LAI , dry matter, straw yield and number of filled grain per panicle. The second sub-group included the other varieties Egyptian Yasmin, IR71137 and IR74052 were high in straw yield.

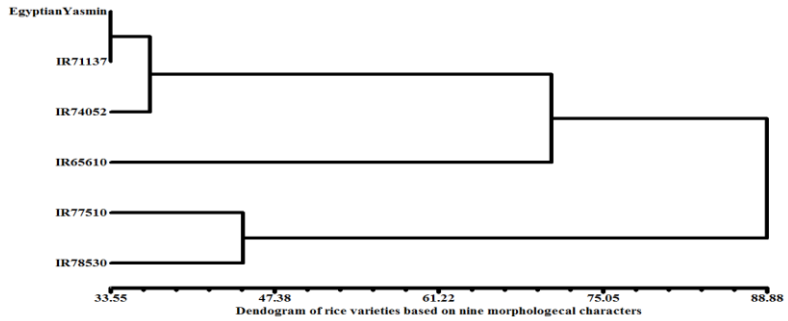

Fig.3. Cluster diagram for six rice varieties classified by nine morphological quantitative characters under third sowing dates (May 24th).

4-4- Under fourth sowing date (June 10th):

Clustering of varieties based on quantitative characters in June 10th Fig.4 shows that clustering divided into two large groups. The first large group included IR65610, IR74052, IR71137 and IR78530 and divided into two sub-group IR65610 variety in branch alone due to leas than all variety in LAI, dry matter, plant height, straw yield and number of filled grains per panicle. While, the second sub-group included IR74052, IR71137 and IR78530, which were similar in LAI, dry matter, number of tillers m^{-2} and number of filled grains per panicle. On the other hand, the second group included the two varieties; Egyptian Yasmin and IR77510 were heights in LAI, dry matter number of tillers m^{-2}, grin yield and number of panicles m^{-2}.

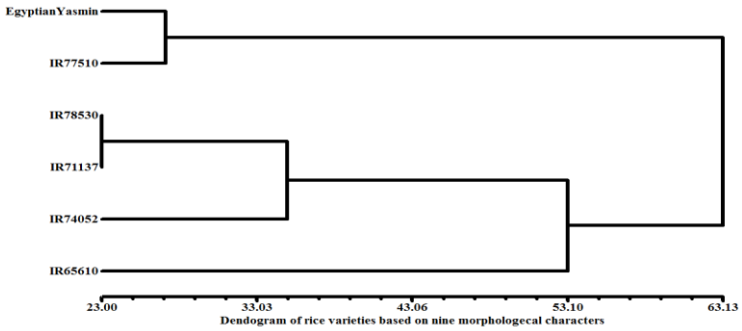

Fig.4. Cluster diagram for six rice varieties classified by nine morphological quantitative characters under fourth sowing dates (June 10th).

5- Estimates of correlation coefficient (CC):

Correlation coefficients were estimated among six varieties for nine agronomic characters listed in (Table 22). Leaf Area Index had highly significant positive correlations with number of tillers m^{-2}. Also, dry matter accumulation g m^{-2}, had highly significant positive correlations with plant height, number of tillers $m^{-2,}$ Straw yield t ha^{-1}, number of panicles per plant, panicle length and significant with panicle weight. While, plant height was highly significantly positive correlated with Straw yield t ha^{-1}, grain yield and number of filled grains per panicle. On the other hand, number of tillers m^{-2} was highly significant positive with grain yield and number of panicles m^{-2}, while straw yield t ha^{-1} had highly significant positive with grain yield t ha^{-1} and number of grains per panicle and significant with 1000 grain weight. Grain yield had highly significant positive with 1000 grain weight and number of grains per panicle and significant positive with number of panicles m^{-2}. Finally, 1000 grain weight was highly significant positive with number of grains per panicle. These results are in agreement with Roy and Kar (1992), Abd El-Aty *et al*. (2002), and Abd Allah *et al*. (2005).

Table (22): Correlation coefficient among vegetative studied characters.

Character	L.A.I	D. M.	P. H.	No.T.	S.Y.	G.Y.	1000g	No.G.	No.P.
L.A.I	1.00	0.317	0.191	0.420*	0.126	0.261	0.365	0.141	0.293
D. M.		1.00	0.672**	0.684**	0.866**	0.936**	0.514*	0.751**	0.420*
P. H.			1.00	0.110	0.723**	0.566**	0.342	0.689**	0.091
No.T.				1.00	0.332	0.569**	0.239	0.161	0.545**
S.Y.					1.00	0.773**	0.465*	0.799**	0.162
G.Y.						1.00	0.552**	0.787**	0.417*
1000g							1.00	0.611**	0.223
No.G.								1.00	0.183
No.P.									1.00

L.A.I: Leaf Area Index D.M.: Dry matter accumulation g m^{-2} P.H.: Plant height cm
No. T.: Number of tillers m^{-2} S.Y.: Straw yield t ha-1 G.Y.: Grain yield t ha^{-1}
1000g: 1000 grain weight g No.G.: Number of filled grains $panicle^{-1}$
No.P.: Number of panicle m^2

This positive correlation might indicate the presence of loci, controlling these traits, on the same linkage group and consequently it might be used for early marker assisted selection (EL-Malky 2004).

CONCLUSION

The results of the present study demonstrated that Aromatic rice varieties varied significantly in most measurements of growth, grain yield and yield attributes, in both seasons. Plants of the Egyptian Yasmin variety having the highest values in the most mentioned traits among the other tested varieties in the two seasons. It can be concluded that the optimum sowing date of Egyptian Yasmin variety is April 24^{th} and May 10^{th} while, sowing date of May 10^{th} is the one optimum for IR 77510, IR 78530 and IR 71137. Generally aromatic varieties i.e. Egyptian Yasmin, IR77510-88-1-3-3,

IR78530-45-3-1-3, IR 74052-177-3-3, IR 71137-51-2 and IR65610-38-2-4-2-6-3 could be recommended to be sown in April 24th and May 10th.

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سلوك بعض أصناف الأرز العطرية في مواعيد زراعة مختلفة تحت الظروف المصرية

تامر فاروق متولي[١]، محمد محمد المالكي[١]، عبدالحميد أحمد جليلة[٢] و عبدالفتاح صبحي غريب[١]

١ مركز البحوث والتدريب في الارز- معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – مصر.

٢ كلية الزراعة – جامعة كفرالشيخ – مصر.

أجريت هذه الدراسة بمزرعة مركز البحوث والتدريب في الأرز بسخا - مركز البحوث الزراعية خلال الموسمين الزراعيين ٢٠٠٨ و ٢٠٠٩ لتقييم بعض سلالات الأرز الأروماتى المبشرة تحت ظروف الزراعة المبكرة والمتأخرة. تم تقيم ست تراكيب وراثية من الأرز الأروماتى منها الصنف المصرى Egyptian Yasmin والخمس أصناف التالية:
(IR77510–88-1-3-3, IR78530-45-3-1-3, IR74052-177-3-3, IR71137-51-2, IR65610-38-2-4-2-6-3).

تمت زراعة مشاتل الأرز فى أربعة مواعيد (٢٤ أبريل ، ١٠ مايو ، ٢٤ مايو ، ١٠ يونيو) فى كل موسم. وأعتبر كل ميعاد من مواعيد الزراعة تجربة مستقلة، وزعت التراكيب الوراثية فى كل منها فى تصميم قطاعات كاملة العشوائية. وقد تم إجراء تحليل التباين المشترك بين مواعيد الزراعة الأربع فى كل موسم زراعة. وتم اخذ عينة خضريه بعد٩٨ يوم من الزراعة لتقدير بعض صفات النمو.

أثرت مواعيد الزراعة معنوياً على المحصول ومكوناته فى كلا الموسمين. أدت الزراعة فى ١٠ مايو الى زيادة في كل من صفات عدد السنابل م$^{-٢}$ وعدد الحبوب بالسنبلة و وزن الألف حبه

(جم) ,محصول الحبوب (طن هكتار$^{-1}$) و محصول القش (طن هكتار$^{-1}$) ونسبة الأروما بالمقارنة بميعاد الزراعة المتأخر ١٠ يونيو فى الموسمين. ولم تظهر إختلافات معنوية بين ميعاد الزراعة الأول فى ٢٤ أبريل وميعاد الزراعة الثانى فى ١٠ يونيو فى محصول الحبوب فى الموسم الأول وفى معظم الصفات الأخرى فى كلا الموسمين. وقد أدى التأخر فى الزراعة الى نقص الصفات السابقة.

أظهرت النتائج وجود إختلافات معنوية بين التراكيب الوراثية للأرز الأروماتى في محصول الحبوب ومكوناته ومنها عدد السنابل م$^{-2}$ وعدد الحبوب بالسنبلة ووزن الألف حبه و محصول الحبوب (طن هكتار$^{-1}$) و محصول القش (طن هكتار$^{-1}$). وقد أعطى الصنف المصري Egyptian Yasmin أعلى محصول حبوب فى الموسمين ولم يختلف عنة الصنف IR77510 فى محصول الحبوب قى الموسم الأول.

وقد أثر التفاعل بين مواعيد الزراعة و التراكيب الوراثية معنويا على محصول الحبوب ومكوناته ورائحة الأروما فى كلا الموسمين. وقد تم الحصول على أعلى محصول حبوب فى موسمى الزراعة من الصنف Egyptian Yasmin المزروع فى ١٠ مايو ولم يختلف عنة معنويا جميع التراكيب الوراثية الأخرى سوى الصنفين IR65610 و IR74052 المزروعة فى نفس الموعد. وبوجه عام فقد أنخفض محصول الحبوب ومكوناته فى جميع التراكيب الوراثية بتأخير ميعاد الزراعة.

قام بتحكيم البحث

أ.د / عادل محمد سلامه — **كلية الزراعة – جامعة المنصورة**

أ.د / عبد السلام عبيد دراز — **مركز البحوث الزراعية**