I.7 INFLUENCE OF TOP LEAF CLIPPING ON GROWTH AND YIELD OF RICE UNDER DIFFERENT SOWING DATES

METWALLY, T.F., E.E. GEWAILY and M.M. EL-MALKY

Rice Res. Dep., Field Crops Res. Inst., ARC, Giza, Egypt

Abstract

Rice (Oryza sativa) is an important cereal crop that is affected by sowing date and some cultural practices. A two-year experiment was conducted at the Farm of Sakha Agric. Res. Stn., Kafr El-Sheikh, Egypt during 2012 and 2013 growing season to study the effect of sowing date (20th of April, 10th of May and 1st of June) and the leaf clipping (without clip (C1), clip flag leaf (C2), clip flag leaf plus second upper leaf (C3) and clip flag leaf plus second and third upper leaves (C4) on grain yield of 12 rice genotypes. The main objective was to study the role of flag, 2nd and 3rd leaf on yield and yield characteristics of some rice genotypes under different sowing dates. The highest number of filled grains panicle^{-1}, panicle length (cm), number of primary branches panicle^{-1}, plant height (cm), number of effective tillers hill^{-1}, and grain yield ha^{-1} were recorded at May 10th plantings which was significantly superior to those of April 20th and June 1st plantation. Genotype, GZ 9461-4-2-3-1 produced the maximum grain yield across leaf removal treatments (8.14 and 8.53 t ha^{-1} in 2012 and 2013 seasons, respectively). Treatments of C2, C3 and C4 resulted in an average decreases in grain yield by 23.2, 30.6 and 42.8 %, respectively compared to C1. Interaction among sowing date, rice genotype and leaf clipping had a significant effect on grain yield in the first season. However, the highest grain yield was obtained by GZ 9461-4-2-3-1, sown on May 10th without clipping.

Keywords: *Oryza sativa* L.– flag leaf - leaf clipping.

INTRODUCTION

Since planting date affects the genetic efficiency of rice in environmental resources consumption, the selection of appropriate planting date is of a high importance for optimum rice productivity (Ali and Rahman, 1992). Environmental condition, as a factor affecting yield related properties of rice, varies at different planting dates. The relationship between environmental condition and yield related properties of plant is well documented (Rudall, 1994).

Sowing and transplanting at the optimum time is important for obtaining high paddy yield. Too early or too late transplanting causes yield reduction due to crop sterility and lower number of productive tillers (Nazir, 1994). Sowing in time ensures that vegetative growth occurs during a period of satisfactory temperature and high levels of solar radiation, and guarantees that grain filling occurs when temperatures are more likely, hence good grain yield and quality were achieved (Farrell *et. al.,* 2003).

Under Egyptian condition, both day length and average temperature during the different growth stages have significant effects on rice yield. Thus, planting date plays a significant role in rice productivity in Egypt (RRTC, 2002). Delaying sowing date sharply decreased the leaf area index, dry matter production and chlorophyll content. In addition, delaying sowing date by 2-4 weeks significantly reduced the period from sowing to heading (El-Khoby, 2004).

Flag leaves play a major role in synthesis and translocation of photo assimilates to the rice seeds, affecting grain yield. Removal of the rice flag leaf at any stage after panicle emergence was reported to cause significant reduction in grain yield (Singh and Ghosh, 1981). Another report showed that flag leaf contributed to 45% of rice grain yield and, when removed, was the major component for yield loss (Abou-Khalifa *et. al.,* 2008). According to Mae (1997), 60–90% of total carbon in the panicles at harvest is derived from photosynthesis after heading, while 80% or more of nitrogen (N) in the panicles at harvest is absorbed before heading and remobilized from vegetative organs. In wheat, up to 34.5% grain yield reduction was reported after flag leaf removal at the heading stage (Mahmood and Chowdhry, 1997), while Birsin (2005) showed that flag leaf removal resulted in approximately 13, 34, 24% reduction in grains per spike, grain weight per spike and 1000-grain weight, respectively, and 2.8% increase in grain protein contents. Similarly, rice flag leaves are also believed to be a major source of remobilized minerals for the seeds, and recent reports tried to correlate gene expression levels on flag leaves with concentration of mineral nutrients in rice seeds (Narayanan *et. al.,* 2007, Sperotto *et. al.,* 2009, 2010). However, to the best of our knowledge, no single report has pointed out that flag leaves as the major source of metals to the rice developing seeds. According to Yoshida (1981) all rice leaves from the flag leaf down to the third leaf from the top export assimilates to the panicle. The top three leaves not only assimilate majority of carbon for grain filling during ripening phase, but provide large proportion of remobilized-nitrogen for grain development during their senescence (Misra and Misra, 1991; Mae, 1997). Viewing these facts, the field experiment was conducted to evaluate the effectiveness of sowing dates, clipping leaves on growth and yield of some rice genotypes.

MATERIALS AND METHODS

This experiment was conducted at at the Farm of Sakha Agric. Res. Stn., Kafr El-Sheikh, Egypt during 2012 and 2013 growing seasons to study the effect of different sowing dates (20th of April, 10th of May and 1st of June) and the flag leaf clipping (without clipping (C1), clip flag leaf (C2), clip flag leaf plus second upper leaf (C3) and clip flag leaf plus second and third upper leaves (C4) on grain yield of 12 rice genotypes. Some chemical and physical properties of the soil of experimental site are presented in Table 1.

Table1. Soil chemical properties of experimental sites during 2012and 2013seasons.

Season	pH	EC DSM^{-1}	OM %	N %	P ppm	Cation and anion meq L^{-1} (soil paste)						
						Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	HCO_3^-	Cl^-	SO_4^{2-}
2012	8.09	2.95	1.51	0.052	14.20	10.04	7.42	1.40	14.10	9.40	19.34	3.22
2013	8.20	2.30	1.60	0.065	18.8	5.40	2.19	0.50	12.30	3.90	15.10	2.20

The experiment was laid out in split-split plots based on RCBD in three replications where main plots were assigned to sowing date (20 April, 10 May and 1 June) and subplots were allocated to rice genotypes (Giza 177, Giza 178, Sakha 105, Sakha 106, GZ 9057-6-1-3-2, GZ 9057-6-3-3, GZ 9577-4-1-1, GZ 9523-2-1-1-1, GZ 9328-1-2-1-3, GZ 9362-34-2-1-3, GZ9461-4-2-3-1 and GZ 9514-3-1-3-1), while the sub-subplots were assigned to leaf clipping treatments (without leaves clip (C1), clip flag leaf (C2), clip flag leaf plus second upper leaf (C3) and clip flag leaf plus second and third upper leaf (C4). Leaves were removed at the heading stage according to the treatments mentioned. According to the experimental design, seeds at the rate of 100 kg ha^{-1} of each genotype were sown on three dates: 20th of April, 10th of May and 1st of June in both 2012 and 2013 season. Seedlings were transplanted to experimental fields 30 days after sowing with a hill spacing of 20cm × 20cm and with 2–3 seedlings per hill. Nitrogen fertilizer at rate of 165 kg N ha^{-1} was added as urea form (46.5% N). Two third of N was applied as basal application, and the other one third was top dressed at 30 days after transplanting (DAT). All plots received identical cultural treatments in terms of ploughing, cultivation, seed rate, sowing method, P, K and Zn fertilizers, and disease control.

At harvest, plant height (cm), number of effective tillers hill^{-1} were counted. Ten panicles were randomly collected from inner rows to estimate the panicle length (cm), number of filled grains and unfilled grains panicle^{-1} and number of primary branches panicle^{-1}. Grain yield was assessed from 4 m^2 (2x2 m) at the center of each plot and adjusted to 14 % moisture content. Data collected were statistically analyzed according to Gomez and Gomez (1984) using GENSTAT, 5th Edition Computer Program.

RESULTS AND DISCUSSION

Effect of sowing date

Data in Tables (2&3) showed that sowing date had a highly significant effect on plant height (cm), panicle length (cm), number of effective tillers hill^{-1}, number of primary branches panicle^{-1}, number of filled grains panicale^{-1}, number of unfilled grains panicale^{-1} and grain yield ha^{-1} at harvest time during both seasons.

The highest values of plant height (cm), panicle length (cm), number of effective tillers hill^{-1}, number of primary branches panicle^{-1}, number of filled grains panicale^{-1}, and grain yield ha^{-1} were recorded on 10th of May sowing date which was significantly superior to each of 20th April and 1st of June. The highest effective tillers hill^{-1} in May 10th plantation might be due to favourable environmental conditions which improved plant development growth as compared to other sowing dates. These results are in agreement with RRTC Report (2002) which reported that several conducted experiments showed that the first of May is the optimum data of sowing rice in Egypt.

Filled grains panicle^{-1} were highest on May 10th sowing (127.7 and 129.9 respectively 2012 and 2013) followed by April 20th (127.2 and 128.5 respectively 2012 and 2013) and lower number of filled grains was observed on June 1st sowing (104.9 and 106.1, respectively, 2012 and 2013) (Table 2). The lower number of filled grains per panicle beyond the May 10th sowing might be due to synchronization of grain filling stage with low temperature, which increased the grain sterility and hence less filled grains percentage. This result is aligned with the findings of Dawadi and Chaudhary (2013). Late sowing shortened the growth period of the plant, which reduced the leaf area, length of panicle and number of grains per panicle compared to early sowing. These results are in line with the findings of Shah and Bhurer (2005) who reported that more number of filled grains per panicle was visualized in the early seeding and declined gradually in the successive seeding dates.

Table 2. Performance of rice genotypes as affected by sowing date and leaf clipping in 2012and 2013 seasons.

Treatment	Plant height (cm)		Panicle length (cm)		No. tiller hill^{-1}		No. primary branches panicle^{-1}	
	2012	2013	2012	2013	2012	2013	2012	2013
Sowing date (S)								
20th of April	91.34	91.93	22.13	22.21	21.39	22.42	10.20	10.48
10th of May	93.77	94.67	22.87	24.31	22.64	22.68	10.49	10.64
1st of June	82.07	82.53	20.94	21.15	12.46	13.15	8.96	9.11
LSD 0.05	0.37	0.42	0.19	0.26	0.29	0.36	0.16	0.14
Genotype (G)								
Giza 177	91.50	92.14	21.26	21.73	19.08	19.89	10.19	10.31
Giza 178	93.05	93.48	22.51	23.11	19.70	20.58	9.89	10.16
Sakha 105	94.11	94.66	21.71	22.28	18.67	19.71	9.87	10.52
Sakha 106	95.20	96.47	21.77	22.49	17.17	18.24	10.18	10.39
GZ 9057-6-1-3-2	89.33	89.72	21.01	21.69	19.31	19.75	9.38	9.59
GZ 9057-6-3-3	89.73	90.30	20.63	21.06	19.47	20.47	9.46	9.62
GZ 9577-4-1-1	87.83	89.73	22.54	23.13	18.09	19.20	10.58	10.72
GZ 9523-2-1-1-1	85.28	86.09	21.80	22.28	18.89	19.82	9.97	10.19
GZ 9328-1-2-1-3	82.22	83.45	21.94	22.49	19.84	20.65	9.46	9.46
GZ 9362-34-2-1-3	82.31	83.55	22.64	23.40	18.11	19.01	9.27	9.35
GZ 9461-4-2-3-1	89.84	89.53	24.21	24.96	19.97	21.28	10.67	10.97
GZ 9514-3-1-3-1	88.33	89.58	21.66	22.04	17.67	18.86	9.72	9.90
LSD 0.05	0.86	0.93	0.52	0.62	0.69	0.64	0.34	0.31
Leaf clipping (C)								
Without	90.66	91.44	23.39	23.72	20.33	20.97	11.67	12.00
Flag leaf	89.03	89.82	22.89	23.56	19.11	20.14	10.18	10.35
Flag +2nd leaf	88.89	89.70	21.41	22.07	18.14	19.54	9.26	9.34
Flag +2nd +3rd leaf	87.94	86.55	20.21	20.85	17.73	18.50	8.44	8.62
LSD 0.05	0.56	0.64	0.27	0.74	0.37	1.06	0.24	0.27
Interaction F test								
SxG	**	**	**	**	**	**	**	**
SxC	**	**	**	**	**	**	**	**
CxG	**	**	NS	NS	**	**	NS	NS
SxCxG	**	**	NS	NS	**	**	NS	NS

Table 3. Performance of rice genotypes as affected by sowing date and leaf clipping in 2012and 2013 seasons.

Treatment	No. filled grains Panicle^{-1}		No. unfilled grains Panicle^{-1}		Grain yield ha^{-1}	
	2012	2013	2012	2013	2012	2013
Sowing date (S)						
20th of April	127.23	128.51	12.34	12.68	7.39	8.05
10th of May	127.68	129.95	10.03	10.92	8.04	8.77
1st of June	104.87	106.14	16.74	17.83	5.95	6.18
LSD 0.05	0.91	0.89	0.38	0.29	0.12	0.17
Genotype (G)						
Giza 177	117.53	118.75	13.44	13.93	6.57	7.13
Giza 178	138.92	140.96	17.53	18.68	7.18	7.70
Sakha 105	105.50	107.58	9.91	10.19	7.32	7.76
Sakha 106	114.00	116.33	12.75	13.14	6.71	7.27
GZ 9057-6-1-3-2	112.94	114.91	12.02	12.82	6.82	7.61
GZ 9057-6-3-3	127.67	129.58	14.03	14.80	7.30	7.95
GZ 9577-4-1-1	117.94	120.57	14.83	15.49	6.90	7.36
GZ 9523-2-1-1-1	110.50	111.61	10.77	11.68	7.12	7.70
GZ 9328-1-2-1-3	112.61	114.43	12.42	13.03	6.93	7.54
GZ 9362-34-2-1-3	110.47	111.45	13.12	13.74	7.30	7.78
GZ 9461-4-2-3-1	150.42	150.90	15.19	15.62	8.14	8.53
GZ 9514-3-1-3-1	121.30	121.62	9.56	10.09	7.28	7.84
LSD 0.05	4.67	1.87	1.13	0.74	0.19	0.32
Leaf clipping (C)						
Without	147.54	150.06	5.62	5.65	9.49	10.01
Flag leaf	127.46	128.36	10.51	11.28	7.25	7.72
Flag +2nd leaf	110.96	112.61	15.89	16.49	6.47	7.07
Flag +2nd +3rd leaf	93.97	95.11	19.78	20.98	5.30	5.87
LSD 0.05	2.61	4.06	0.55	0.45	0.17	0.40
Interaction F test						
SxG	**	**	**	**	**	**
SxC	**	**	**	**	**	**
CxG	**	**	**	**	**	NS
SxCxG	**	**	**	**	**	NS

Data also showed that significantly more unfilled grains panicale^{-1} was observed on June 1st sowing (16.7 and 17.8 in 2012 and 2013 seasons, respectively). On the other hand, sowing date of 10 May produced lowest number of unfilled grains panicale^{-1} (Table2). Lower number of unfilled grains panicale^{-1} in early sowing was due to optimum photoperiod that enhanced plant growth, development and starch filling in the grains. This result is in line with the findings of Dawadi and Chaudhary (2013).

Data also showed that grain yield of sowing date on 10th May increased by about 8.1 and 27.8% than sowing dates on 20th of April and 1st of June, respectively. This might have been due to that sowing date of 10 May produced the highest effective tillers hill^{-1} (22.6 and 22.7 in 2012 and 2013 seasons, respectively) and the highest number of filled grains panicale^{-1} (127.7 and 129.9 in 2012 and 2013 seasons, respectively). Delaying the sowing date beyond the first half of May will shorten rice vegetative phase. A shorter vegetative period means less carbohydrates and mineral accumulation in the different plant organs which, in turn, will be translocated to the panicle. Consequently, low yields will be expected. Similar conclusion was previously drawn by Nahar *et. al.* (2009) and Metwally *et. al.* (2012).

Effect of genotypes

Data in Tables (2&3) showed that there were significant differences among rice genotypes for all studied traits. Plant height differed significantly among rice genotypes. The maximum plant height was recorded in Sakha 106 whereas minimum plant height was observed in GZ 9328-1-2-1-3 (Table 2). Panicle length with genotypes differed significantly among each other (Table 2). GZ 9461-4-2-3-1 had longer panicles (24.2 and 24.9 cm, respectively 2012 and 2013 seasons), which was significantly longer than other genotypes, while GZ 9057-6-3-3 gave the shortest panicle during both seasons. Significant differences were found in the production of effective tillers hill^{-1} among rice genotypes (Table 2). GZ 9461-4-2-3-1 produced higher number of effective tillers hill^{-1}, while Sakha 106 produced lower number of effective tillers hill^{-1}. The difference in tiller production among cultivars may be attributed to varietals characters (Chandrashekhar *et. al.,* 2001).

Data also showed that GZ 9461-4-2-3-1 produced the highest number of primary branches panicle^{-1}, while GZ 9362-34-2-1-3 produced the lowest number of primary branches panicle^{-1} during both growing seasons (Table 2). Among the varieties, relatively higher number of filled grains panicle^{-1} were recorded in GZ 9461-4-2-3-1 (150.42 and 150.90 in 2012 and 2013, respectively) while the lowest number of filled grains panicle^{-1} was obtained with Sakha 105. In both seasons, Giza 178 had the highest number of unfilled grains panicle^{-1} which was significantly more than other genotypes. GZ 9514-3-1-3-1 produced the lowest number of unfilled grains panicle^{-1}. Grain yield was significantly influenced by different rice genotypes. The results showed that genotype GZ 9461-4-2-3-1 produced the maximum grain yield (8.14 and 8.53 t ha^{-1} respective 2012 and 2013 seasons). Higher yield in the GZ 9461-4-2-3-1 was attributed to the higher number of effective tillers hill^{-1}, more panicle length and higher numbers of filled grains panicle^{-1}. The minimum grain yield (6.6 and 7.1 t ha^{-1} respectively 2012 and 2013 season) was obtained from Giza 177, which was statistically similar with Sakha 106 in both seasons.

Effect of leaf clipping

Results revealed significant influences of leaf clipping on all studied traits, Tables (2&3). All the studied parameters showed maximum values under C1 (without leaves clipped) except values of number of unfilled grains panicle^{-1}. The values decreased significantly in order C1, C2, C3 and C4. From data in Table 2 treatments of C2, C3 and C4 resulted in an average decrease number of filled grains panicle^{-1} by 14.14, 24.97 and 36.56 %, respectively compared to C1. Flag leaf has an important role in grain filling (Asli *et. al.,* 2011). Supply of assimilates from other sources such as flag leaf sheath and the leaves below the flag leaf can somewhat compensate the lack of flag leaf, although contribution of flag leaf in grain filling is more than 12 % (Das and Mukharjee, 1989).

Data in Table 2 also showed that the highest number of unfilled grains panicle^{-1} was obtained with C4 treatment, while the lowest number of unfilled grains panicle^{-1} was obtained with C1 treatment. Khatun *et. al.* (2011) reported that flag leaf in particular provides photosynthate for grain filling. The uppermost leaves receive higher quantity of sunlight (Sarkar *et. al.,* 1998) and higher photosynthetic activity as compared to lower leaves. When flag leaf was removed the rice crop was deprived of having sufficient amount of photosynthates, which increases unfertile grains and fertile grains were not filled properly.

Data showed also that plant height (cm), number of effective tillers hill^{-1} and grain yield ha^{-1} were significantly influenced by different clipping leaf treatments, which gave the highest values when the leaves were not clipped (C1) while, the lowest values were obtained with C4 treatment. This result was consistent with the findings of Abou-Khalifa *et. al.* (2008) and Khatun *et. al.* (2011) which concluded that leaf cutting reduced grain yield. It's worthy noted that treatments of C2, C3 and C4 resulted in an average decrease in grain yield by 23.2, 30.6 and 42.8 percent respectively compared to C1. These results are in agreement with Asli *et. al.* (2011) who reported that removal of the flag leaf blade at anthesis resulted in a decrease of 18 % in rice grain yield because the flag leaf blade is the principal source of photoassimilates imported by grains during grain filling. Tari *et. al.* (2009) reported that the top three leaves, especially flag leaf contributes most to grain yield. Greater carbohydrate translocation from vegetative plant parts to the spikelets and larger leaf area index (LAI) takes place during the grain filling period. They also indicated that flag leaf has an important role in rice yield by increasing grain weight by about 41 to 43 percent.

Interaction effects

Plant height was highly significantly affected by the interaction between SxG, SxC, GxC and SxGxC (Table 4). Interactions between sowing date and genotype showed that in the first season, Sakha 105 had the highest value of plant height (100 cm) sown on 10 May (S2). On the other hand, in the second season Sakha 106 had the highest value of plant height (101.1cm) sown on 10 May (S2). Interaction between sowing date by clipping leaves in 2012 season, showed that the tallest plants were obtained at 20 April sowing (S1) when the leaves were not clipped (C1), while in 2013 season, the tallest plants were obtained at 10 May sowing (S2) when the flag leaf was clipped (C2). The shortest plants were obtained at 1 June sowing (S3) when the three leaves were clipped (C4). Interaction between rice genotype by clipping leaves showed that in both seasons, genotype Sakha 106 gave taller plants than other genotypes without clipping, while genotype of GZ 9328-1-2-1-3 gave the shortest plants when the three leaves were clipped (C4). Interaction of sowing date, rice genotypes and clipping leaves had a significant effect on plant height. However, the tallest plants were obtained with Sakha 106, sown on 20 April (S1) without clipping.

Number of effective tillers hill^{-1} was highly significantly affected by interaction among SxG, SxC, GxC and SxGxC (Table 5). The interaction of GZ 9461-4-2-3-1with May 10 sowing produced the highest number of effective tillers hill^{-1}(24.6 and 26.1 in 2012 and 2013, respectively) and it was significantly higher than all other interactions of sowing dates and rice genotypes. GZ 9577-4-1-1 produced the lowest number of effective tillers hill^{-1} (11.4 and 10.6 in 2012 and 2013, respectively) with June 1 sowing. Interaction of C1 (no leaf clipping) with S2 (10 May sowing) produced the highest number of effective tillers hill^{-1} (24.1) in the first season while, interaction of C2 (flag leaf clipped) with S2 (10 May sowing) produced the highest number of effective tillers hill^{-1} (24.8) in the second season. On the other hand, in both seasons, interaction of C4 treatment with S3 (June 1 sowing) produced the lowest number of effective tillers hill^{-1}.

Table 4. Plant height (cm) as affected by the interactions between sowing date, genotype, and leaf clipping during 2012 and 2013 seasons.

Sowing date	Genotype	2012				2013			
		C1	C2	C3	C4	C1	C2	C3	C4
20th of April	Giza 177	97.67	91.67	89.33	87.33	100.41	91.74	90.04	87.26
	Giza 178	96.33	95.67	94.33	95.33	98.59	95.74	94.18	95.37
	Sakha 105	99.33	96.67	93.67	93.00	100.70	96.30	94.78	92.67
	Sakha 106	101.00	97.00	95.00	94.33	102.67	97.22	95.11	96.92
	GZ 9057-6-1-3-2	96.00	92.33	91.00	89.00	95.78	92.26	91.37	89.44
	GZ 9057-6-3-3	97.67	89.33	88.33	88.33	97.52	89.70	89.15	88.26
	GZ 9577-4-1-1	93.00	89.33	90.33	87.67	95.67	89.70	90.92	87.52
	GZ 9523-2-1-1-1	88.00	86.00	87.33	84.33	90.00	87.00	87.81	84.26
	GZ 9328-1-2-1-3	87.67	83.33	83.33	82.33	87.96	85.26	84.37	81.70
	GZ 9362-34-2-1-3	89.67	83.33	84.33	84.33	92.08	84.92	86.25	84.04
	GZ 9461-4-2-3-1	98.67	94.33	94.33	92.00	90.96	96.92	95.04	91.78
	GZ 9514-3-1-3-1	95.33	92.33	92.33	91.00	96.81	93.26	93.55	91.66
	Mean	95.03	90.94	90.30	89.08	95.76	91.67	91.05	89.24
10th of May	Giza 177	97.67	98.00	97.66	97.33	97.74	99.22	99.30	98.26
	Giza 178	98.67	97.67	99.33	98.33	99.19	98.29	97.81	97.92
	Sakha 105	98.00	99.00	100.67	101.00	98.93	100.89	99.52	101.78
	Sakha 106	102.67	101.00	100.00	91.67	99.00	101.44	102.56	101.41
	GZ 9057-6-1-3-2	92.00	97.67	97.33	96.33	91.89	98.52	98.37	97.92
	GZ 9057-6-3-3	92.67	100.00	98.67	98.33	92.30	100.89	100.96	99.92
	GZ 9577-4-1-1	86.00	92.00	91.66	90.33	97.33	93.44	93.96	92.25
	GZ 9523-2-1-1-1	89.00	91.00	90.33	89.67	90.78	92.67	91.81	91.30
	GZ 9328-1-2-1-3	89.00	84.67	84.67	83.67	89.78	85.63	86.52	85.96
	GZ 9362-34-2-1-3	83.00	86.00	85.33	84.33	84.23	87.11	86.48	85.81
	GZ 9461-4-2-3-1	92.67	95.67	95.33	95.67	92.30	96.96	96.37	96.96
	GZ 9514-3-1-3-1	91.33	93.00	92.67	92.00	91.70	94.89	94.19	94.00
	Mean	92.72	94.64	94.47	93.22	93.76	95.83	95.65	95.29
1st of June	Giza 177	87.66	86.33	84.00	83.33	87.74	87.59	83.78	82.59
	Giza 178	88.67	85.00	84.00	83.3	89.19	86.00	84.67	84.81
	Sakha 105	88.00	87.33	86.67	86.00	88.93	87.25	87.96	86.22
	Sakha 106	91.67	90.00	89.00	89.00	92.00	89.77	89.22	90.33
	GZ 9057-6-1-3-2	82.00	79.00	79.33	80.00	81.89	78.78	79.48	80.89
	GZ 9057-6-3-3	82.67	79.67	80.33	80.67	82.30	80.63	80.70	81.19
	GZ 9577-4-1-1	86.00	81.67	83.00	83.00	87.33	81.74	84.56	82.33
	GZ 9523-2-1-1-1	81.00	78.67	79.67	78.33	80.78	79.30	79.30	78.04
	GZ 9328-1-2-1-3	79.00	76.00	77.00	76.00	79.78	75.33	78.67	76.44
	GZ 9362-34-2-1-3	80.00	75.00	76.00	76.33	81.23	76.67	76.89	76.92
	GZ 9461-4-2-3-1	82.67	79.00	78.67	79.00	82.30	78.11	78.07	78.56
	GZ 9514-3-1-3-1	81.33	80.33	80.00	78.33	81.70	82.37	82.33	78.48
	Mean	84.22	81.50	81.47	81.11	84.60	81.96	82.14	81.40
Average		90.66	89.03	88.75	87.80	91.37	89.82	89.61	88.64

C1: Without, C2: Flag leaf, C3: Flag +2nd leaf, C4:Flag +2nd +3rd leaf

Data also showed that interaction effect of rice genotype and clipping leaf treatments had significant influence on number of effective tillers hill^{-1}. In general, GZ 9461-4-2-3-1 with different clipping leaf treatment produced more number of effective tillers hill^{-1} whereas Sakha 106, GZ 9362-34-2-1-3 and GZ 9514-3-1-3-1 with different clipping leaf treatments recorded lower number of effective tillers hill^{-1}. Interaction of sowing date, rice genotypes and leaf clipping had significant effect on number of effective tiller hill^{-1}. However, in both seasons the highest number of effective tillers hill^{-1} was observed with GZ 9461-4-2-3-1, sown on 10 May (S2) without leaf clipping.

Number of filled grains panicle^{-1} was highly significantly affected by the interaction between SxG, SxC, GxC and SxGxC in both seasons (Table 6). Interaction between sowing date and genotype showed that in both seasons genotype of GZ 9461-4-2-3-1 had the highest number of filled grains panicle^{-1} when sown on 20 April (S1). Interaction between sowing date and leaf clipping (Table 6) showed also that in both seasons, the highest number of filled grains panicle^{-1} was obtained on 10 May sowing (S2) when the clipped leaves were not clipped (C1), while the lowest number of filled grains panicle^{-1} was obtained with 1st June sowing (S3) when the three leaves were clipped (C4). Interaction between rice genotype and leaf clipping showed that genotype of GZ 9461-4-2-3-1 gave higher number of filled grains panicle^{-1} than other genotypes when the leaves were not clipped. Interaction of sowing date, rice genotype and leaf clipping had significant effect on number of filled grains panicle^{-1}. However, higher number of filled grains panicle^{-1} was observed with GZ 9461-4-2-3-1, sown on 10 May (S2) without clipping.

Data in Table 7 revealed a significant effect for the interaction among sowing date (S), genotypes (G) and leaf clipping (C) on number of unfilled grains panicle^{-1}. The interaction of GZ 9362-34-2-1-3 with April 20 sowing produced the lowest number of unfilled grains panicle^{-1} and it was significantly lower than all other sowing dates and rice genotype interactions. Giza 178 produced the highest number of unfilled grains panicle^{-1} with June 1 sowing. Data also showed that interaction of C1 (no leaves clipped) with S1 (20 April sowing) gave the lowest number of unfilled grains panicle^{-1}, while interaction of C4 (three leaves clipped) with S3 (June 1 sowing) gave the highest number of unfilled grains panicle^{-1}. Interaction among SxGxC had a significant effect on number of unfilled grains panicle^{-1}. However, lower number of unfilled grains panicle^{-1} was observed with GZ 177, sown on 1 June (S3) without clipping.

Table 5. Number of effective tillers hill-1 as affected by the interaction between sowing date, genotype, and leaf clipping during 2012 and 2013 seasons.

Sowing date	Genotype	2012				2013			
		C1	C2	C3	C4	C1	C2	C3	C4
20th of April	Giza 177	23.00	22.67	22.33	21.67	22.77	23.74	23.25	22.41
	Giza 178	24.33	23.33	22.67	23.00	25.48	24.48	23.85	23.89
	Sakha 105	24.00	22.67	21.00	22.00	23.78	23.74	22.22	23.22
	Sakha 106	21.00	20.00	19.67	19.33	23.11	20.89	21.08	20.70
	GZ 9057-6-1-3-2	22.67	21.67	21.00	18.00	23.85	22.19	21.89	19.22
	GZ 9057-6-3-3	24.33	23.33	22.00	21.67	23.81	23.92	23.33	22.41
	GZ 9577-4-1-1	19.00	19.67	19.67	20.67	20.67	20.41	20.85	21.63
	GZ 9523-2-1-1-1	22.33	20.67	21.67	21.67	24.26	21.41	21.96	22.23
	GZ 9328-1-2-1-3	23.00	22.67	22.67	21.33	23.22	23.74	24.52	22.26
	GZ 9362-34-2-1-3	20.67	20.00	18.67	18.33	21.19	20.89	21.22	19.15
	GZ 9461-4-2-3-1	26.33	22.33	20.00	19.33	27.19	23.59	20.41	20.15
	GZ 9514-3-1-3-1	20.33	20.67	19.67	18.00	23.59	21.41	21.74	18.89
	Mean	22.58	21.64	20.92	20.42	23.58	22.53	22.19	21.35
10th of May	Giza 177	24.00	21.00	20.33	19.67	23.00	22.89	22.26	20.19
	Giza 178	24.67	23.33	20.67	21.00	22.52	23.37	22.41	21.78
	Sakha 105	22.33	22.00	20.67	20.33	23.59	24.22	22.19	21.26
	Sakha 106	21.67	21.00	19.67	19.67	22.46	22.89	21.74	20.19
	GZ 9057-6-1-3-2	26.00	23.33	21.33	21.33	23.19	24.70	22.59	22.48
	GZ 9057-6-3-3	25.00	24.33	21.00	20.33	24.89	26.04	23.56	23.26
	GZ 9577-4-1-1	22.00	26.00	24.00	23.67	23.44	27.44	26.00	24.52
	GZ 9523-2-1-1-1	22.33	24.33	23.67	23.33	22.48	26.25	25.96	24.48
	GZ 9328-1-2-1-3	25.67	24.67	23.67	23.67	25.30	26.19	25.52	24.52
	GZ 9362-34-2-1-3	25.00	21.33	20.33	20.67	26.06	23.26	22.59	21.30
	GZ 9461-4-2-3-1	27.33	24.33	23.67	24.00	27.70	26.26	25.41	25.33
	GZ 9514-3-1-3-1	23.00	22.00	21.67	21.67	23.56	24.22	24.19	22.85
	Mean	24.08	23.14	21.72	21.61	24.02	24.81	23.70	22.68
1st of June	Giza 177	15.00	13.33	12.33	12.67	17.00	14.37	13.37	13.41
	Giza 178	13.67	14.00	13.00	10.67	15.52	15.33	14.00	11.30
	Sakha 105	13.33	12.67	11.33	11.67	13.59	14.19	12.37	12.08
	Sakha 106	11.67	10.67	10.67	11.00	12.46	10.63	11.63	11.11
	GZ 9057-6-1-3-2	17.00	13.00	13.33	12.00	18.19	12.56	13.92	12.22
	GZ 9057-6-3-3	15.00	12.33	12.67	11.67	16.89	12.48	13.52	11.52
	GZ 9577-4-1-1	12.00	10.00	10.67	9.67	13.44	9.89	11.74	10.41
	GZ 9523-2-1-1-1	12.33	12.00	11.67	10.67	12.48	12.22	12.74	11.41
	GZ 9328-1-2-1-3	15.67	12.67	12.33	10.00	15.30	13.19	13.04	11.00
	GZ 9362-34-2-1-3	17.00	12.33	11.00	12.00	17.06	11.78	12.04	11.52
	GZ 9461-4-2-3-1	16.33	16.00	12.33	11.67	18.19	17.37	13.33	13.37
	GZ 9514-3-1-3-1	13.00	11.67	10.00	10.33	13.56	10.96	11.00	10.26
	Mean	14.33	12.56	11.78	11.17	15.31	12.91	12.73	11.63
Average		20.33	19.11	18.14	17.73	20.97	20.09	19.54	18.55

C1: Without, C2: Flag leaf, C3: Flag +2nd leaf, C4: Flag +2nd +3rd leaf

Table 6. Number of filled grains panicle-1 as affected by the interaction between sowing date, genotype, and leaf clipping during 2012 and 2013 seasons.

Sowing date	Genotype	2012				2013			
		C1	C2	C3	C4	C1	C2	C3	C4
20th of April	Giza 177	145.67	120.33	114.00	96.33	160.78	129.56	119.56	103.19
	Giza 178	176.00	154.33	135.33	120.33	173.52	155.08	141.19	107.26
	Sakha 105	136.33	118.33	101.33	87.00	145.11	108.19	102.04	91.08
	Sakha 106	148.33	112.67	98.00	89.33	164.11	134.37	107.81	97.78
	GZ 9057-6-1-3-2	146.00	129.67	101.67	101.67	151.30	117.15	104.26	91.96
	GZ 9057-6-3-3	167.00	160.67	127.00	99.67	166.08	136.63	123.44	113.92
	GZ 9577-4-1-1	160.33	138.00	132.67	107.67	159.11	126.63	114.41	99.96
	GZ 9523-2-1-1-1	140.00	126.33	102.00	85.33	151.33	126.19	114.67	107.56
	GZ 9328-1-2-1-3	136.33	129.67	112.67	95.00	165.81	124.41	108.78	99.74
	GZ 9362-34-2-1-3	140.00	133.33	114.33	100.00	151.85	114.22	100.33	89.04
	GZ 9461-4-2-3-1	187.33	181.67	164.67	137.67	193.22	167.52	150.11	109.04
	GZ 9514-3-1-3-1	145.33	140.00	120.00	89.67	170.67	143.37	127.70	107.70
	Mean	152.39	137.08	118.64	100.81	162.74	131.94	117.86	101.52
10th of May	Giza 177	157.00	130.00	120.00	102.67	146.74	121.00	119.00	98.00
	Giza 178	171.67	153.67	140.67	107.33	179.11	159.00	139.00	122.67
	Sakha 105	144.00	107.67	101.33	91.67	140.04	122.33	106.00	86.00
	Sakha 106	160.00	133.33	108.33	98.00	151.81	118.33	103.67	90.33
	GZ 9057-6-1-3-2	149.67	116.33	103.33	91.67	145.78	137.33	108.67	104.33
	GZ 9057-6-3-3	165.00	135.67	123.00	112.33	173.67	163.56	130.67	102.67
	GZ 9577-4-1-1	156.00	125.67	113.67	98.67	165.33	141.78	138.33	113.67
	GZ 9523-2-1-1-1	150.00	125.67	114.00	108.00	142.67	128.67	105.00	86.67
	GZ 9328-1-2-1-3	164.33	123.67	109.00	98.67	140.26	127.00	112.33	100.67
	GZ 9362-34-2-1-3	152.67	113.00	99.00	88.33	143.11	133.67	116.33	102.33
	GZ 9461-4-2-3-1	191.00	167.00	151.00	108.33	184.15	172.67	166.67	148.67
	GZ 9514-3-1-3-1	168.00	141.33	128.33	108.33	148.81	137.33	122.33	89.33
	Mean	160.78	131.08	117.64	101.17	155.12	138.56	122.33	103.78
1st of June	Giza 177	125.67	112.33	101.67	84.67	126.74	113.15	103.63	83.63
	Giza 178	156.00	143.00	115.33	93.33	159.11	145.33	114.37	92.59
	Sakha 105	116.33	100.00	92.00	70.00	120.04	101.11	95.11	73.89
	Sakha 106	128.33	110.00	98.00	83.67	131.81	113.33	100.89	81.74
	GZ 9057-6-1-3-2	126.00	116.33	98.67	74.33	125.78	117.81	98.74	75.81
	GZ 9057-6-3-3	140.00	125.33	90.67	85.67	143.56	126.92	87.19	86.63
	GZ 9577-4-1-1	118.00	99.67	88.67	76.33	121.78	96.96	89.41	79.48
	GZ 9523-2-1-1-1	120.00	103.33	84.33	67.00	122.67	103.26	85.37	65.22
	GZ 9328-1-2-1-3	116.33	102.33	92.00	71.33	120.26	104.59	95.22	74.15
	GZ 9362-34-2-1-3	120.00	110.00	87.33	67.67	123.11	113.33	85.48	64.63
	GZ 9461-4-2-3-1	161.33	138.00	113.33	103.67	164.15	136.00	116.48	102.19
	GZ 9514-3-1-3-1	125.33	110.33	97.33	81.67	128.81	103.04	99.92	80.41
	Mean	129.44	114.22	96.61	79.95	132.32	114.57	97.65	80.03
	Average	147.54	127.46	110.96	93.97	150.06	128.36	112.61	95.11

C1: Without, C2: Flag leaf, C3: Flag +2nd leaf, C4:Flag +2nd +3rd leaf

Table 7. Number of unfilled grains panicle-1 as affected by the interaction between sowing date, genotype, and leaf clipping during 2012 and 2013 seasons.

Sowing date	Genotype	2012				2013			
		C1	C2	C3	C4	C1	C2	C3	C4
20th of April	Giza 177	6.33	11.00	15.00	18.67	2.44	4.00	17.55	21.59
	Giza 178	11.67	13.00	17.67	18.33	8.78	9.89	14.41	18.96
	Sakha 105	5.67	6.33	11.33	15.00	3.48	8.26	9.74	11.74
	Sakha 106	7.33	9.33	13.33	19.33	3.52	7.19	14.55	14.96
	GZ 9057-6-1-3-2	6.33	11.00	14.33	15.33	3.77	6.44	13.04	16.33
	GZ 9057-6-3-3	5.33	9.00	16.33	21.33	4.78	7.70	12.96	13.04
	GZ 9577-4-1-1	6.00	10.00	16.67	23.33	6.39	8.22	13.00	14.78
	GZ 9523-2-1-1-1	5.33	12..67	18.67	13.33	5.37	6.08	12.52	14.92
	GZ 9328-1-2-1-3	6.00	9.33	15.67	16.67	5.22	8.48	14.08	20.57
	GZ 9362-34-2-1-3	5.67	10.00	14.67	13.00	2.44	6.30	10.96	12.22
	GZ 9461-4-2-3-1	10.00	13.33	17.33	19.00	7.74	8.74	13.30	16.04
	GZ 9514-3-1-3-1	3.33	8.33	13.00	13.00	4.56	6.52	12.52	13.92
	Mean	6.58	10.06	15.33	17.19	4.87	7.32	13.22	15.76
10th of May	Giza 177	3.00	9.00	13.00	18.33	2.44	17.66	20.00	30.33
	Giza 178	9.00	11.00	15.67	16.67	8.78	20.33	33.33	48.00
	Sakha 105	3.33	7.33	10.67	11.67	3.48	11.00	16.33	19.00
	Sakha 106	3.67	8.67	11.00	14.67	7.19	10.67	20.33	32.00
	GZ 9057-6-1-3-2	4.00	6.00	13.33	15.00	3.77	14.33	21.00	25.00
	GZ 9057-6-3-3	5.00	7.33	10.67	14.33	4.77	18.33	24.67	37.00
	GZ 9577-4-1-1	6.00	8.00	12.00	15.00	6.39	20.00	21.33	39.00
	GZ 9523-2-1-1-1	4.33	4.67	12.67	15.33	5.37	12.00	13.33	17.00
	GZ 9328-1-2-1-3	5.00	6.33	14.67	20.00	5.22	14.00	17.33	23.67
	GZ 9362-34-2-1-3	4.67	5.00	9.67	11.00	4.30	23.33	28.67	32.00
	GZ 9461-4-2-3-1	7.67	8.67	13.67	15.33	7.74	17.33	25.00	30.67
	GZ 9514-3-1-3-1	5.00	6.67	13.33	12.67	4.56	8.66	13.67	15.67
	Mean	5.06	7.39	12.53	15.00	5.33	15.64	21.25	29.11
1st of June	Giza 177	2.00	17.00	19.00	29.00	5.59	10.78	16.00	18.74
	Giza 178	9.00	19.00	23.00	46.33	8.29	14.67	20.41	18.25
	Sakha 105	3.33	7.00	18.00	19.33	5.18	8.52	11.26	14.22
	Sakha 106	6.66	10.00	18.00	31.00	6.23	8.15	13.81	19.03
	GZ 9057-6-1-3-2	4.00	14.00	19.00	22.00	7.26	12.56	15.25	15.04
	GZ 9057-6-3-3	5.00	16.00	23.00	35.00	6.37	9.22	16.92	21.92
	GZ 9577-4-1-1	6.00	15.00	27.00	33.00	7.50	12.22	16.74	20.25
	GZ 9523-2-1-1-1	4.33	11.00	12.33	14.67	6.15	13.41	14.92	19.08
	GZ 9328-1-2-1-3	5.00	13.33	15.00	22.00	5.78	9.26	14.01	18.74
	GZ 9362-34-2-1-3	4.67	21.00	27.00	31.00	5.74	9.78	12.11	17.08
	GZ 9461-4-2-3-1	7.66	17.00	24.00	28.67	9.78	14.15	17.48	19.50
	GZ 9514-3-1-3-1	5.00	8.33	12.33	13.67	6.92	8.04	11.11	14.89
	Mean	5.20	14.06	19.81	27.14	6.73	10.90	15.00	18.06
Average		5.61	10.50	15.89	19.78	5.65	11.28	16.49	20.98

C1: Without, C2: Flag leaf, C3: Flag +2nd leaf, C4: Flag +2nd +3rd leaf

Grain yield was highly significantly affected by interaction between SxG, SxC, GxC and SxGxC in first season, while it was highly significantly affected by interaction between SxG and SxC in the second season (Table 8). Interaction between sowing date and genotype showed that in both seasons, genotype GZ 9461-4-2-3-1 had the highest grain yield when sown on 10 May (S2). Interaction between sowing date and leaf clipping data in Table 8 showed also that, in both seasons, the highest grain yield was obtained on 10th of May sowing (S2) without clipping (C1), while the lowest grain yield was obtained at 1 June sowing (S3) when three leaves were clipped (C4). Interaction between rice genotype and leaf clipping in the first season showed that genotype GZ 9461-4-2-3-1 produced higher grain yield than other genotypes without clipping. Interaction of sowing date, rice genotypes and leaf clipping had significant effect on grain yield in the first season. However, the highest grain yield was obtained with GZ 9461-4-2-3-1, which was sown on 10th of May (S2) when the clipped leaves were not done. Tari *et. al.* (2009) found that flag leaf and morphophysiological characteristics were influenced significantly by nitrogen fertilization levels. Early transplanting date with application of 138 kg N ha-1 for the best performance of flag leaf and yield attributes.

Table 8. Grain yield t ha-1 as affected by the interaction between sowing date, genotype, and leaf clipping during 2012 and 2013 seasons.

Sowing date	Genotype	2012				2013			
		C1	C2	C3	C4	C1	C2	C3	C4
20th of April	Giza 177	8.81	6.87	6.81	5.59	8.87	7.67	7.94	6.43
	Giza 178	9.84	7.62	6.62	5.43	10.66	7.55	7.39	6.33
	Sakha 105	9.76	7.54	7.33	5.74	10.45	8.18	7.58	6.63
	Sakha 106	8.73	6.98	6.54	5.67	9.47	7.52	7.24	6.49
	GZ 9057-6-1-3-2	8.73	6.75	6.62	5.74	9.78	7.47	7.02	6.65
	GZ 9057-6-3-3	9.44	7.25	7.14	5.98	10.74	8.23	7.36	6.78
	GZ 9577-4-1-1	9.13	7.30	7.10	5.90	9.50	7.87	6.89	6.72
	GZ 9523-2-1-1-1	9.21	6.90	7.33	6.14	10.19	8.07	7.24	6.96
	GZ 9328-1-2-1-3	9.13	6.98	6.86	5.74	9.91	7.79	7.48	6.65
	GZ 9362-34-2-1-3	10.48	7.38	7.10	6.06	11.40	7.94	7.31	6.83
	GZ 9461-4-2-3-1	11.83	7.94	7.73	5.51	12.79	8.41	7.71	6.36
	GZ 9514-3-1-3-1	8.60	7.57	7.22	6.22	9.26	8.40	7.42	7.05
	Mean	9.47	7.26	7.03	5.81	10.25	7.93	7.38	6.66
10th of May	Giza 177	9.41	7.41	6.30	5.59	10.29	8.18	7.12	5.95
	Giza 178	11.39	8.68	6.60	5.43	11.88	9.43	7.47	6.17
	Sakha 105	10.29	9.08	7.33	5.74	11.13	9.69	7.39	6.39
	Sakha 106	9.33	7.97	6.54	5.66	10.07	8.79	7.36	6.33
	GZ 9057-6-1-3-2	11.87	7.33	6.62	5.74	12.58	8.86	7.39	6.57
	GZ 9057-6-3-3	11.52	8.60	7.25	5.98	12.26	9.43	8.23	6.72
	GZ 9577-4-1-1	9.65	8.05	7.10	5.90	10.34	8.90	7.94	6.65
	GZ 9523-2-1-1-1	10.28	8.37	7.33	6.14	11.06	9.19	8.07	6.88
	GZ 9328-1-2-1-3	10.52	7.97	6.86	5.74	11.09	8.75	7.71	6.49
	GZ 9362-34-2-1-3	10.68	8.29	7.10	6.06	11.59	9.03	7.07	6.91
	GZ 9461-4-2-3-1	13.43	10.70	8.23	6.01	13.27	12.47	8.33	6.28
	GZ 9514-3-1-3-1	11.16	9.00	7.57	6.22	12.03	9.74	8.23	7.21
	Mean	10.79	8.45	7.07	5.85	11.47	9.37	7.69	6.55
1st of June	Giza 177	7.75	5.43	4.71	4.14	7.913	5.88	5.01	4.24
	Giza 178	8.70	6.22	5.59	4.00	8.79	6.54	5.79	4.16
	Sakha 105	8.46	6.22	5.59	4.71	8.43	6.54	5.87	4.82
	Sakha 106	7.98	5.82	5.11	4.13	8.10	6.29	5.42	4.18
	GZ 9057-6-1-3-2	7.75	5.58	4.87	4.26	7.91	6.06	5.18	4.05
	GZ 9057-6-3-3	8.38	6.14	5.43	4.48	8.56	6.86	5.67	4.58
	GZ 9577-4-1-1	7.82	5.74	5.03	4.05	7.86	6.18	5.30	4.16
	GZ 9523-2-1-1-1	8.22	5.90	5.19	4.48	8.33	6.30	5.43	4.71
	GZ 9328-1-2-1-3	8.06	5.90	5.19	4.24	8.31	6.35	5.48	4.44
	GZ 9362-34-2-1-3	8.30	6.14	5.43	4.56	8.45	6.48	5.61	4.76
	GZ 9461-4-2-3-1	9.02	6.94	6.22	4.10	9.08	7.02	6.55	4.10
	GZ 9514-3-1-3-1	7.98	6.06	5.43	4.32	8.16	6.37	5.67	4.51
	Mean	8.20	6.01	5.32	4.29	8.32	6.41	5.58	4.39
Average		9.49	7.24	6.47	5.32	10.01	7.90	6.89	5.87

C1: Without, C2: Flag leaf, C3: Flag +2nd leaf, C4:Flag +2nd +3rd leaf

CONCLUSION

From the above-mentioned results we could conclude that the highest grain yield was recorded with GZ 9461-4-2-3-1, sown on May 10th without leaf clipping. The flag leaf had more important role in grain yielding than 2nd and 3rd leaf of the studied promising rice genotypes.

REFERENCES

1. Abou-Khalifa, A.A.B., A.N. Misra, and A.E.A.K.M. Salem. 2008. Effect of leaf cutting on physiological traits and yield of two rice cultivars. African Journal of Plant Science, 2:147–150.
2. Ali, M.Y. and M.M. Rahman. 1992. Effect of seedling age and transplanting time on late planted Aman rice. Bangladesh Journal of Training and Development. 5:75-83.
3. Asli, D. E., A. Eghdami, and A. Houshmandfar. 2011. Evaluation of sink and source relationship in different rice (*Oryza sativa* L.) cultivars. Advances in Environmental Biology, 5(5):912-919.
4. Birsin, M.A. 2005. Effects of removal of some photosynthetic structures on some yield components in wheat. Tarim Bilimleri Dergisi-Journal of Agricultural Science, 11:364–367.
5. Chandrasekhar, J., R.G. Rana, B. Ravindranath, and K.B. Reddy. 2001. Physiological analysis of growth and productivity in hybrid rice (*Oryza Sativa*). Indian J. Plant Physiology, 6(2):142-146.
6. Das, N.R. and N. Mukharjee. 1989. Effect of seedling age and leaf removal on rice grain and straw yield. IRRI NewsLetter, 14:1-29.
7. Dawadi, K.P. and N.K. Chaudhary. 2013. Effect of sowing dates and varieties on yield and yield attributes of direct seeded rice in Chitwan, Nepal. International Journal of Agricultural Science Research Vol. 2(4), pp. 095-102.
8. El-Khoby, W.M. 2004. Study the effect of some cultural practices on rice crop. Ph. D. thesis, Fac. Agric. Kafr El-sheikh, Tanta. Univ.
9. Farrell T.C., K. Fox, R.L. Williams, S. Fukai, and L.G. Lewin. 2003. Avoiding low temperature damage in Australia's rice industry with photoperiod sensitive cultivars. Proceedings of the 11th Australian Agronomy Conference. Geelong, 2-6 February (2002). Deakin University, Australia. p. 35.
10. Gomez, K.A. and A.A. Gomez. 1984. Statistical procedure for agicultural research. 2nd Ed. Johin Wiley Sons. New yourk. USA.

11. Khatun, M.M., M.A. Hazrat, and L.G. Mateo. 2011. Influences of leaf cutting on growth and yield of rice. J. bio-sci. 19:99-100
12. Mae, T. 1997. Physiological nitrogen efficiency in rice Nitrogen utilization, photosynthesis, and yield potential. Plant and Soil 196:201-210.
13. Mahmood, N., and M.A. Chowdhry. 1997. Removal of green photosynthetic structures and their effect on some yield parameters in bread wheat. Wheat Information Service, 85:14–20.
14. Metwally, T.F., M.M. El-Malky, A.A. Glelah, and A.S. Gharieb. 2012 Performance of Elite Aromatic Rice Varieties under Different Sowing Dates under Egyptian Condition. J. Plant Production, Mansoura Univ., Vol. 3 (2):311– 333.
15. Misra, A.N., and M. Misra. 1991. Physiological responses of pearl millet to agroclimatic conditions. In: Prakash R, Ali A (eds) Environmental Contamination and Hygien, Jagmandir Books, New Delhi, India, India, pp. 165-175.
16. Nahar, K., H. Mirza and R.R. Majumder. 2009. Effect of low temperature stress in transplanted aman rice varieties mediated by different transplanting dates. Acad. J. Plant Sci., 2 (3):132-138.
17. Narayanan, N.N., M.W. Vasconcelos, and M.A. Grusak. 2007. Expression profiling of *Oryza Sativa* metal homeostasis genes in different rice cultivars using a c DNA macroarray. Plant Physiology and Biochemistry, 45:277–286.
18. Nazir, M.S. 1994. Crop Production. (Ed.): E. Bashir and R. Bantel. National Book Foundation, Islamabad. pp. 252.
19. RRTC, 2002. Rice in Egypt. Rice Research and Training Center, Ministry of Agriculture and land Reclamation:98-99.
20. Rudall, P. 1994. Anatomy and systematic of Iridaceae. Bot. J.Linn. Soc. 114(1):1-21.
21. Sarkar, R.K., S. Abhijit, and M. Yamagishi. 1998. Leaf positional changes in the rates of photosynthesis and specific leaf weight, chlorophyll, nitrogen content and their relationship in rice. Indian J. Plant Physiol. 3 (2), 135-139.
22. Shah, L.M. and K.P. Bhurer. 2005. Response of wet seeded rice varieties to sowing dates. Nepal Agric.Res. J., 6:35-38.
23. Singh, T. and A.K. Ghosh. 1981. Effect of flag leaf on grain yield of transplanted rice. International Rice Research Institute, 6: 5.
24. Sperotto, R.A., T. Boff, G.L. Duarte, L.S. Santos, M.A.Grusak, and J.P. Fett. 2010. Identification of putative target genes to manipulate Fe and Zn concentrations in rice grains. Journal of Plant Physiology, 167:1500–1506.

25. Sperotto, R.A., F.K. Ricachenevsky, G.L. Duarte, T. Boff, K.L. Lopes, E.R. Sperb, M.A. Grusak, and J.P. Fett. 2009. Identification of up-regulated genes in flag leaves during rice grain filling and characterization of OsNAC5, a new ABA-dependent transcription factor. Planta, 230:985–1002.
26. Tari, D.V., H.A. Pirdashti, and M. Nasiri. 2009. Investigation Some Agronomical Traits of Rice Under Different Transplanting Dates, Planting Space and Nitrogen Fertilization Levels in North of Iran. World Applied Science Journal 6 (8):1021-1027.
27. Yoshida, S. 1981. Fundamentals of rice crop production. Published by International Rice Research Institute, Los Banos, Laguna, Philippine.

١-٧ تأثير قطع الأوراق القمية على نمو ومحصول الأرز تحت مواعيد زراعة مختلفة

تامر فاروق متولي، السيد السيد الجويلي، محمد محمد المالكي

قسم بحوث الأرز – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر

يعد الأرز من المحاصيل التى تتاثر بمواعيد الزراعة وكذلك بالمعاملات الزراعية المختلفة. و قد أجريت تجربة حقلية خلال موسمي زراعة الأرز ٢٠١٢ و ٢٠١٣ بالمزرعة البحثية لمحطة البحوث الزراعية بسخا، كفر الشيخ وذلك لدراسة تأثر ١٢ تركيبا وراثيا بمواعيد زراعة مختلفة وهى ٢٠ أبريل، ١٠مايو، ١ يونيو وكذلك تأثرها بمعاملات إزالة الأوراق القمية وهى: بدون قطع، قطع ورقة العلم، قطع ورقة العلم بالإضافة إلى الورقة التالية لها وقطع ورقة العلم بالإضافة إلى الورقتين التاليتين لها. كان الهدف الرئيس من هذا البحث هو دراسة دور ورقة العلم وكذا الورقة الثانية والثالثة على صفات المحصول ومكوناته لبعض التراكيب الوراثية للأرز تحت مواعيد زراعة مختلفة. وقد أوضحت النتائج أن الزراعة فى ١٠ مايو قد أعطى أعلى القيم لعدد الحبوب الممتلئة لكل سنبلة، طول السنبلة، عدد السنيبلات، ارتفاع النبات، عدد الفروع المنتجة للسنابل وأعلى محصول للحبوب وذلك مقارنة بمواعيد الزراعة الأخرى. أعطت السلالة المبشرة GZ 9461-4-2-3-1 أعلى محصول للحبوب مقارنة بالأصناف و السلالات الأخرى. كما أدى إزالة الأوراق إلى نقصان فى محصول الحبوب بمقدار ٢٣.٢، ٣٠.٦ ، ٤٠.٨% لكل من إزالة ورقة العلم، إزالة ورقة العلم بالإضافة إلى الورقة التالية لها و قطع ورقة العلم بالإضافة إلى الورقتين التاليتين لها، على التوالى مقارنة بعدم إزالة الأوراق. وقد أوضحت النتائج أيضا أن التفاعلات المختلفة للمعاملات كان له تأثيرا عالي المعنوية على محصول الحبوب في موسم الزراعة ٢٠١٢ حيث أنتجت السلالة المبشرة GZ 9461-4-2-3-1 أعلى محصول حبوب عند زراعتها فى العاشر من مايو وذلك عند عدم إزالة أي أوراق من النبات.