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INFLUENCE OF SOWING DATE ON YIELD AND YIELD ATTRIBUTES OF RICE GENOTYPES AND INFESTATION BY RICE LEAFMINER AND RICE STEM BORER

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ABSTRACT: A field experiment was conducted at the experimental farm of Rice Research Department, Sakha, Kafr El-Sheikh, Egypt during 2020 and 2021 seasons. The objective of study was to study the effect of three sowing dates (May1st, May15th and June1st) on yield, yield attributes of 21 rice genotypes, and infestation by rice leaf miner (*Hydrellia prosternalis* Deem.) and rice stem borer (*Chilo agamemnon* Bles.). Sowing date significantly affected all studied characters in both seasons. The highest values of flag leaf area, number of panicles per hill, panicle weight, total number of grains per panicle, percentage of filled grain, 1000-grain weight and grain yield were recorded in the earliest sowing date, while the lowest values were obtained with the latest one. Statistical analysis revealed that the rice genotypes were significantly different in all the studied traits. The highest values of grain yield and most of the studied characters were observed in Giza 179 and GZ10804-3-1-2-2-2, followed by Giza 178 and Sakha 108 rice cultivars. Rice leaf miner infestation significantly increased as the sowing was later. Giza 178 and Giza 179 rice cultivars suffered the highest infestation, followed by GZ 9399-4-1-1-2-1-2 and GZ 10778-17-1-6-1 promising lines. The rice stem borer infestation significantly decreased by delaying the sowing date. GRYT-26-17-178, GRYT-29-17-178 lines and Korea 27 rice genotypes recorded the highest infestation with both dead hearts and white heads.

Key words: Rice genotype, sowing date, grain yield, stem borer, leaf miner.

INTRODUCTION

Rice is one of the most important cereal crops for about half of the world’s population. It is grown in about 114 countries, mostly developing nations in Asia and Africa. In Egypt, rice is one of the most important sources for human feeding and for foreign currency earning as an exportable crop. During 2020 season, the area cultivated with rice in Egypt was 1.307 million feddans with an average productivity of 3.87 t fed^{-1}, and total production of 4.80 million tons of rough rice (RRTC, 2020).

Sowing date significantly influences growth and yield of rice crop. Sowing rice at suitable time ensures that vegetative stage occurs during a period of optimum temperatures and sufficient solar radiation. In addition, grain filling coincides milder temperatures consequently, good grain quality (Farrell *et al.,* 2003 and Patel *et al*., 2019). Metwally *et al*., (2012) and Osman (2019) reported that early rice sowing, early May enhances plant height, number of panicles/hill, number of filled grains/ panicle and rice grain yield.

Insect infestations are one of biotic factors, and rice plants are liable to be attacked by several insect pests. In Egypt, the rice stem borer, *Chilo agamemnon* Bles. and the rice leaf miner, *Hydrellia prosternalis* Deeming are the most important (Sherif 2002). Sowing date of rice affects degree of rice infestation by the rice leafminer and the rice stem borer, which are the most destructive rice pests. The occurrence and prevalence of insect pests are affected by host plant availability, growth stage, sowing and transplanting dates (El-Malky and El-Zun 2014). Due to the insect pests, there was severe damage to the rice grain yield during the different growth stages. The rice yield losses due to the stem borer ranged from 18 to 25% in India (Baladhiya *et al*., 2018). Rice leaf miner has become an important insect pest in Egypt, particularly in late sown

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rice. El-Habashy (2011) estimated the losses in rice yield due to this insect as about 14-18% in rice sown by late May or early June.

Rajpoot *et al.* (2019) investigated the effect of rice sowing date on rice stem borer, *Scirpophaga incertulas* Walker infestation. The pest incidence was least at early sown rice (July1st), decreased on rice sown by mid-July, but least at late sown rice (July31th). On the other hand, the highest yield was obtained with early sowing. Shalaby (2018) found high rice infestations by rice leafminer and stem borer at late plantings, and the early planting helped the crop to avoid high insect infestations and increased rice yield.

The objectives of the current study were to investigate the effect of rice sowing dates on the infestation by the rice leafminer, *Hydrellia prosternalis* Deem., and rice stem borer, *Chilo agamemnon* Bles. In addition, the rice yield and yield attributes of rice genotypes, as influenced by sowing dates, were considered.

MATERIALS AND METHODS

A field experiment was carried out at the experimental farm of the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt, during 2020 and 2021 seasons. Twenty-one rice genotypes; eight commercial cultivars as well as 13 promising lines (Table 1) were evaluated for insect infestation and rice yield. The preceding crop was wheat in both seasons of study.

Records of temperature, relative humidity and solar radiation were obtained from the Meteorological Station located at Soil, Water and Environment Research Institute, Agricultural Research Center, Egypt during both seasons of study (Table 2).

Table (1): Rice genotypes, parentage, origin and type.

Genotype	Parentage	Origin	Type
Giza 177	Giza171/Yomji No.1//Pi No.4	Egypt	Japonica
Giza 178	Giza 175/Milyang 49	Egypt	Indica /Japonica
Giza 179	GZ1368/GZ6296	Egypt	Indicia /Japonica
Sakha 108	Sakha 101/HR5824//Sakha 101	Egypt	Japonica
Sakha 106	Giza177/Hexi30	Egypt	Japonica
Sakha 107	Gz 3310-20-3-3/Sakha 103// Gz 3310	Egypt	Japonica
Sakha 109	Sakha 105/ Sakha 101	Egypt	Japonica
GZ 10333-9-1-1-3	SKC 23822/	Egypt	Japonica
Korea 27	Introduction	South Korea	Indica
GZ 10101-5-1-1-1	Sakha 103/IRAT385	Egypt	Japonica
GZ 10598-9-1-5-5	IET16775/ Yumlen 55	Egypt	Japonica
GZ 10590-1-1-3-9-1	GZ 8126-1-3-1-2/HR 17570-21-5-2-5-2	Egypt	Indica/ japonica
GZ 10804-3-1-2-2-2	GZ 7576/IR81828	Egypt	Japonica
GZ 10631-1-1-2-4	Giza 177/ WAB 891S633	Egypt	Japonica
GZ 10686-2-1-3-4	Sakha 104/ WARB 450	Egypt	Japonica
GZ 10717-3-5-1-1	Gz 6322-15-1-1-3/AC 2879 (S. 105)	Egypt	Japonica
GZ 10778-17-1-6-1	Giza 178/ IR 81328-74-2-2-2	Egypt	Indica /Japonica
GZ 10848-1-2-2-1	Giza 178/ SKC 23893	Egypt	Indica /Japonica
GZ 9399-4-1-1-2-1-2	Giza 178/ IR 65844	Egypt	Indica /Japonica
GRYT-26-17-178	Giza 178/ SKC 23819	Egypt	Indica /Japonica
GRYT-29-17-178	Giza 178/ SKC 23819	Egypt	Indica /Japonica

Table (2): Weather parameters of experimental site (as recorded by Meteorological Station at Soil, Water and Environment Research Institute).

Month	Week	2020				2021			
		Solar Radiation $MJ/m^2/day$	Temperature °C		R H %	Solar Radiation $MJ/m^2/day$	Temperature °C		R H %
			Max.	Min.			Max.	Min.	
May	1	26.50	27.92	13.68	65.85	26.06	37.87	18.73	47.24
	2	24.60	31.70	14.53	61.56	26.43	34.58	17.14	50.27
	3	26.62	38.71	19.53	56.46	28.73	34.63	17.53	51.11
	4	28.47	29.72	15.89	55.14	28.96	36.12	18.16	49.40
Average		26.55	32.01	15.91	59.75	27.55	35.80	17.89	49.51
June	1	28.01	34.33	16.96	51.48	28.91	32.35	18.02	52.04
	2	28.18	35.81	19.32	48.27	27.56	36.36	19.78	49.97
	3	28.29	37.00	20.37	48.28	28.77	35.04	19.82	50.00
	4	28.54	36.21	20.63	55.58	28.20	39.39	22.36	54.04
Average		28.26	35.84	19.32	50.90	28.36	35.79	20.00	51.51
Jul	1	28.65	39.28	21.70	51.61	28.45	38.68	22.57	51.24
	2	27.23	37.12	22.58	56.88	28.04	38.10	22.69	55.13
	3	27.95	36.27	21.54	55.63	27.88	39.46	23.70	50.75
	4	27.04	38.23	22.21	55.58	26.58	37.94	23.25	54.49
Average		27.72	37.73	22.01	54.93	27.74	38.55	23.05	52.90
August	1	27.34	38.94	22.59	55.85	25.84	42.20	23.99	50.62
	2	25.90	37.32	23.39	57.39	26.15	39.12	24.42	55.37
	3	26.10	37.45	22.67	56.45	25.60	37.76	23.26	56.46
	4	24.90	38.27	22.90	56.89	24.60	38.40	23.51	57.19
Average		26.06	38.00	22.89	56.65	25.55	39.37	23.80	54.91
September	1	22.97	38.51	22.93	58.74	23.55	35.99	22.91	56.50
	2	22.32	37.58	22.81	60.05	21.76	36.35	22.89	53.17
	3	21.26	37.34	22.71	57.45	21.78	36.46	22.58	56.24
	4	20.41	37.35	22.36	59.56	20.29	33.17	20.99	57.76
Average		21.74	37.70	22.70	58.95	21.85	35.49	22.34	55.92
October	1	19.62	35.68	21.46	58.03	18.53	31.47	20.18	56.80
	2	18.30	34.81	20.88	60.17	18.85	33.94	19.20	60.98
	3	16.69	33.71	19.87	61.67	16.53	31.00	19.10	55.81
	4	14.91	31.28	20.16	60.56	15.01	31.01	19.13	60.60
Average		17.38	33.87	20.59	60.11	17.23	31.86	19.40	58.55

1. Experimental design

The genotypes were laid out in a randomized complete block design with three replications in each sowing date in both seasons. A combined analysis was used to analyze the differences among the three sowing dates in each season.

2. Land preparation, sowing, and transplanting

Both nursery and paddy field were well-prepared as recommended. The seeds of the 21 genotypes were soaked in water for 24 hours, and then incubated for additional 48 hours to hasten rice seed germination. Pre-germinated seeds were uniformly broadcasted in the nurseries on May1st, May15th and June1st in both seasons. Seedlings were pulled out form the nursery 30 days after sowing and transferred to the permanent field. Seedlings were manually transplanted as 4 seedlings/hill, with 20x20 cm spacing between hills and rows. The plot size measured 12 m^2. The recommended cultural practices were applied through the rice growing season, but without pesticide applications.

3. Agronomic characters

The considered traits were: flag leaf area, number of panicles per hill, panicle weight, total number of grains per panicle, percentage of filled grains, 1000-grain weight and grain yield.

4. Insect infestations

4.1. Rice Leafminer, *Hydrellia prosternalis* Deem.

Twenty days after transplanting, 100 rice leaves were picked up from each rice plot. Percentages of infested leaves by rice leafminer were recorded. According to the standard evaluation system of Rice Research and Training Center (RRTC, 2016), Sakha, Egypt, the rice infestations were categorized as Resistant = 0 - 10%, moderately resistant >10 - 20%, moderately susceptible >20-30%, susceptible >30 - 40% and highly susceptible > 40 %.

4.2. Rice Stem Borer, *Chilo agamemnon* Bles.

Two symptoms of rice stem borer infestation were considered; dead hearts at maximum tillering stage, and white heads three weeks before harvest. Twenty-five hills were cut from each plot to evaluate the percentages of the abovementioned symptoms. The genotypes were categorized as: Resistant = 0 - 3%, moderately resistant > 3 - 6%, moderately susceptible > 6 - 9 %, susceptible > 9 - 12 % and highly susceptible > 12 % (RRTC, 2016).

5. Statistical analysis:

The analysis of variance by means of "COSTAT" computer software package was carried out as combined analysis for the three sowing dates and two seasons according to Gomez and Gomez (1984). Significantly differed means were compared by least significat differences (LSD) at probability 0.05.

RESULTS

1. Agronomic characters

1.1. Flag leaf area

Flag leaf area was significantly affected by rice genotype, sowing date and the interaction as presented in Table (3). GRYT-26-17-178 line had the greatest flag leaf area (43.18 and 41.56 cm^2) in contrast with plants of Sakha 106 variety, which recorded the lowest ones (27.31 and 28.04 cm^2) in the two seasons, respectively. Means of flag leaf areas over the genotypes showed that rice sown on May1st produced the greatest flag leaf area, while that sown later produced less value. The flag leaf areas were reduced by 8.00 and 21.13% in the first season, and by 8.69 and 19.57% in the second season when sowing date was delayed to May 15th and June 1st, respectively.

1.2. Number of panicles/hill

The ability of tested rice genotypes to produce panicles per hill was affected significantly by sowing date and genotype Table (4). Giza 178 rice cultivar produced the greatest number of panicles per hill, followed by Sakha106 and GZ 10631-1-1-2-4 line, while the least number of panicles per hill was recorded with Korea 27 in 2020 season. In 2021 season, the greatest number of panicles per hill was recorded with Giza 178 and GZ 10631-1-1-2-4 line. On the other hand, GZ 10804-3-1-2-2-2 line produced the least number. It was noted that planting rice on May1st or May15th recorded higher number of panicles per hill, while delaying planting significantly reduced number of panicles per hill. Compared to the earliest date, number of panicles was reduced by 5.50 and 11.16% in the second and third dates, respectively in 2020, and by 2.24 and 6.20%, respectively in 2021 season.

Table (3): Flag leaf area of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean (cm^2)	May1st	May15th	June1st	Mean (cm^2)
Giza 177	37.23	38.20	34.83	36.79	39.37	34.33	33.40	35.70
Giza 178	43.40	39.70	35.53	39.55	40.80	37.73	35.47	38.00
Giza 179	39.27	35.40	35.23	36.63	37.50	35.67	34.10	35.76
Sakha 108	41.40	38.30	33.20	37.63	37.70	35.27	33.30	35.42
Sakha 106	29.60	26.71	25.60	27.31	31.27	28.40	24.47	28.04
Sakha 107	37.90	35.90	29.77	34.53	35.60	31.70	28.67	31.99
Sakha 109	36.23	29.20	22.40	29.28	35.43	30.17	22.63	29.41
GZ 10333-9-1-1-3	38.10	33.67	27.63	33.18	38.53	31.33	23.57	31.14
Korea 27	46.93	44.30	34.97	42.10	41.30	38.17	33.70	37.72
GZ 10101-5-1-1-1	41.27	35.20	29.37	35.28	39.83	35.27	30.57	35.22
GZ 10598-9-1-5-5	43.80	42.17	25.70	37.23	42.43	39.67	24.60	35.57
GZ 10590-1-1-3-9-1	34.50	31.27	25.63	30.47	30.73	29.10	24.73	28.19
GZ 10804-3-1-2-2-2	43.20	38.10	29.03	36.78	40.10	36.83	28.77	35.23
GZ 10631-1-1-2-4	31.57	29.70	27.23	29.50	32.23	29.40	26.87	29.50
GZ 10686-2-1-3-4	37.73	33.60	27.83	33.10	33.37	28.90	25.17	29.14
GZ 10717-3-5-1-1	39.60	36.20	25.00	33.60	37.23	31.73	24.30	31.10
GZ 10778-17-1-6-1	34.03	28.77	24.43	29.10	30.47	28.53	25.50	28.17
GZ 10848-1-2-2-1	34.77	33.67	31.97	33.47	36.70	34.33	32.67	34.57
GZ 9399-4-1-1-2-1-2	35.27	32.23	31.27	32.92	31.47	31.10	31.90	31.49
GRYT-26-17-178	44.13	43.27	42.13	43.18	42.30	41.33	41.03	41.56
GRYT-29-17-178	41.70	39.33	40.63	40.56	41.43	39.20	38.47	39.70
Mean (cm^2)	38.61	35.52	30.45		36.94	33.73	29.71	
Reduction %	-	8.00	21.13		-	8.69	19.57	
LSD 0.05								
Sowing (S):	3.69				1.61			
Genotypes (G):	1.95				1.41			
S x G:	3.39				2.44			

Table (4): Number of panicles/hill of rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	24.33	23.67	24.00	24.00	24.77	24.65	23.33	24.25
Giza 178	28.00	27.33	26.33	27.22	28.00	26.67	26.37	27.01
Giza 179	27.00	25.33	24.33	25.56	25.73	24. 73	24.00	24.83
Sakha 108	25.67	24.57	22.00	24.10	26.35	24.57	23.33	24.75
Sakha 106	27.33	27.20	25.33	26.63	26.17	25.70	24.68	25.51
Sakha 107	25.33	22.30	19.33	22.23	25.33	24.23	23.27	24.28
Sakha 109	25.33	24.67	24.43	24.81	26.53	25.69	24.37	25.53
GZ 10333-9-1-1-3	27.67	25.00	21.00	24.55	26.00	25.33	24.73	25.35
Korea 27	21.00	19.03	18.67	19.57	22.77	21.31	21.63	21.90
GZ 10101-5-1-1-1	21.61	20.67	19.00	20.43	24.17	22.67	20.77	22.53
GZ 10598-9-1-5-5	25.50	23.03	21.33	23.29	22.61	21.73	21.37	21.90
GZ 10590-1-1-3-9-1	27.00	25.37	22.00	24.79	26.93	25.69	24.67	25.76
GZ 10804-3-1-2-2-2	24.33	23.10	22.67	23.37	22.13	22.37	19.81	21.43
GZ 10631-1-1-2-4	26.33	25.67	25.33	25.78	26.33	25.47	25.20	25.67
GZ 10686-2-1-3-4	22.57	21.00	20.67	21.41	23.77	24.20	22.60	23.49
GZ 10717-3-5-1-1	25.30	24.67	24.00	24.67	26.60	25.33	24.23	25.39
GZ 10778-17-1-6-1	24.33	22.00	21.00	23.44	25.93	25.14	24.00	25.02
GZ 10848-1-2-2-1	25.00	23.43	22.00	23.47	25.20	23.77	21.47	23.48
GZ 9399-4-1-1-2-1-2	21.33	21.13	20.67	21.04	23.73	23.10	22.50	23.11
GRYT-26-17-178	26.33	24.67	20.67	23.89	26.73	25.34	24.87	25.65
GRYT-29-17-178	22.33	21.03	18.63	20.67	23. 59	23.43	22.57	23.20
Mean	24.91	23.54	22.13		24.99	24.43	23.44	
Reduction %	-	5.50	11.16		-	2.24	6.20	
LSD at 0.05								
Sowing (S):	1.18				0.80			
Genotypes (G):	0.86				0.76			
S x G:	2.05				1.39			

1.3. Panicle weight (g)

Panicle weight was affected significantly by rice genotype, sowing date and the interaction as presented in Table (5). GRYT-26-17-178 line produced the heaviest panicles in contrast to GZ 10598-9-1-5-5 line which produced the lowest panicle weight. Means of panicle weight due to different sowing dates showed that May1st cultivation had the heaviest panicles, with 3.73g, that was reduced by 5.10 and 15.01% in the second and third cultivations, respectively in 2020 season, and was reduced by 5.85 and 19.60% in the second and third cultivations, respectively in 2021 season.

Table (5): Panicle weight of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean (g)	May1st	May15th	June1st	Mean (g)
Giza 177	3.72	3.47	3.25	3.48	3.54	3.28	2.93	3.25
Giza 178	4.01	3.87	2.90	3.59	3.92	3.67	3.47	3.68
Giza 179	3.77	3.67	3.43	3.63	4.16	3.79	3.01	3.65
Sakha 108	4.11	4.07	3.54	3.91	4.27	3.98	3.23	3.83
Sakha 106	3.10	2.98	3.01	3.03	3.83	3.78	3.73	3.78
Sakha 107	3.67	3.58	3.15	3.47	4.11	3.65	3.02	3.59
Sakha 109	3.48	3.35	3.05	3.29	3.43	3.10	2.89	3.14
GZ 10333-9-1-1-3	3.62	3.28	2.77	3.23	3.53	3.47	3.30	3.44
Korea 27	4.11	3.78	3.08	3.67	4.52	4.26	3.60	4.12
GZ 10101-5-1-1-1	3.21	3.10	2.91	3.07	3.58	3.17	2.51	3.08
GZ 10598-9-1-5-5	3.71	2.98	2.78	2.99	3.42	3.27	2.70	3.13
GZ 10590-1-1-3-9-1	3.71	3.54	2.49	3.25	3.87	3.53	3.01	3.81
GZ 10804-3-1-2-2-2	3.73	3.36	3.11	3.40	4.27	3.95	3.40	3.87
GZ 10631-1-1-2-4	3.30	3.12	2.78	3.07	3.46	3.33	2.45	3.08
GZ 10686-2-1-3-4	3.31	3.25	3.17	3.24	3.67	3.45	2.68	3.27
GZ 10717-3-5-1-1	3.38	3.26	3.20	3.28	3.21	3.17	2.87	3.08
GZ 10778-17-1-6-1	3.41	3.36	3.03	3.26	3.71	3.50	2.64	3.28
GZ 10848-1-2-2-1	4.08	3.67	2.84	3.53	4.31	4.09	2.58	3.99
GZ 9399-4-1-1-2-1-2	4.08	3.73	3.21	3.67	4.35	3.98	3.76	4.03
GRYT-26-17-178	4.84	4.43	3.90	4.39	4.81	4.63	3.72	4.38
GRYT-29-17-178	4.82	4.54	3.43	4.26	4.61	4.32	3.23	4.05
Mean (g)	3.73	3.54	3.17		3.93	3.70	3.16	
Reduction %	-	5.10	15.01		-	5.85	19.60	
LSD at 0.05								
Sowing (S):	0.03				0.21			
Genotypes (G):	0.19				0.21			
S x G:	0.21				0.37			

1.4. Total number of grains/panicle

The highest number of grains/panicle (179.10) was detected with the promising line, GRYT-29-17-178 (Table 6) followed by Giza-178 cultivar (169.30) and Giza-179 cultivar (142.10), while the least number of grains/panicle (120.06) was obtained with Gz10598-9-1-5-5. On the other hand, the earliest planting date (May1st) was accompanied by the highest number of grains/panicle (139.41 and 147.95), while the latest date had the lowest number of grains/panicle (132.58 and 133.53) in 2020 and 2021 seasons, respectively. Thus, sowing on May 15th resulted in 0.24 and 3.84% reductions in number of grains/panicle, and sowing on June 1st reduced number of grains by 5.15 and 9.75% in the first and second seasons, respectively.

Table (6): Total number of grains per panicle of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	135.30	131.90	133.30	133.52	131.93	128.86	129.03	129.90
Giza 178	181.6	173.40	153.00	169.30	175.13	168.80	154.80	166.24
Giza 179	149.60	143.10	133.60	142.10	167.70	160.10	142.20	156.67
Sakha 108	145.90	135.23	125.20	141.50	141.73	136.23	129.47	135.81
Sakha 106	129.20	125.40	125.10	125.27	135.23	130.30	125.37	130.30
Sakha 107	129.30	129.20	114.70	124.39	143.57	131.50	123.20	132.76
Sakha 109	127.77	128.90	124.60	127.10	133.63	130.00	121.97	128.53
GZ 10333-9-1-1-3	131.23	131.20	124.10	128.90	143.40	130.13	122.23	131.43
Korea 27	155.17	149.90	131.70	145.60	147.80	144.60	137.40	143.27
GZ 10101-5-1-1-1	121.60	119.57	118.50	119.90	132.70	128.90	127.10	129.57
GZ 10598-9-1-5-5	120.63	119.33	120.21	120.06	125.93	122.37	113.73	120.67
GZ 10590-1-1-3-9-1	136.03	138.20	117.50	130.60	145.63	138.70	121.60	135.31
GZ 10804-3-1-2-2-2	143.90	142.90	135.60	140.80	147.90	146.40	145.00	146.45
GZ 10631-1-1-2-4	129.27	128.00	128.10	128.46	142.60	139.60	135.10	139.10
GZ 10686-2-1-3-4	141.10	143.70	140.40	141.70	154.93	145.10	136.50	145.51
GZ 10717-3-5-1-1	132.60	125.13	118.20	125.31	128.67	125.10	120.57	124.76
GZ 10778-17-1-6-1	135.10	132.00	131.10	133.39	151.63	146.43	139.30	145.79
GZ 10848-1-2-2-1	133.83	133.53	109.90	125.74	148.30	138.10	119.30	135.23
GZ 9399-4-1-1-2-1-2	136.90	136.70	130.70	134.77	173.80	164.90	131.40	156.70
GRYT-26-17-178	167.00	166.33	161.17	164.90	159.63	157.13	155.00	157.26
GRYT-29-17-178	184.80	183.00	169.40	179.10	178.10	174.43	170.90	174.50
Mean	139.41	139.07	132.58		147.95	142.27	133.53	
Reduction %	-	0.24	5.15		-	3.84	9.75	
LSD at 0.05								
Sowing (S):	1.03				4.59			
Genotypes (G):	3.10				2.06			
S x G:	5.36				3.57			

1.5. Percentage of filled grains

In 2020 season (Table 7), percentage of rice filled grains was highest in Giza 178 (93.69%), Giza 177 (93.23%) and Sakha 106 (92.55%), but was lowest with GRYT-26-17-178 and GRYT-29-17-178 promising lines. The evaluated genotypes varied significantly in such trait. Also, genotypes of filled grains exhibited significant differences according to date of sowing. The earliest date (May 1st) produced the highest average (93.99%), followed by the second date (91.43%) and then, the third date (89.15% filled grains). Data of the second season took a trend similar to that of the first season. Thus, the percentages of filled grains decreased by 2.72 and 1.73 due to delay sowing to May 15th and by 5.15 and 4.21% due to delay sowing to June 1st in 2020 and 2021seasons, respectively.

Table (7): Percentage of filled grains of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	94.18	93.97	91.55	93.23	94.24	94.54	92.91	93.87
Giza 178	94.70	94.43	91.37	93.51	95.48	94.48	92.71	94.22
Giza 179	93.26	92.30	90.39	91.98	94.11	91.97	89.34	91.81
Sakha 108	96.02	90.95	89.73	92.23	95.20	93.86	91.70	93.85
Sakha 106	95.00	92.40	90.25	92.55	95.78	93.96	92.19	93.98
Sakha 107	93.60	91.37	87.72	90.90	93.35	90.74	87.62	90.57
Sakha 109	95.02	92.52	91.13	92.89	94.72	92.87	90.46	92.68
GZ 10333-9-1-1-3	94.89	92.87	88.63	92.13	95.22	94.25	92.05	93.85
Korea 27	95.83	90.70	88.17	91.57	94.06	90.57	88.23	90.98
GZ 10101-5-1-1-1	93.54	93.88	90.97	92.80	93.12	90.91	89.49	91.17
GZ 10598-9-1-5-5	95.23	92.90	88.81	92.31	95.10	92.98	91.03	93.04
GZ 10590-1-1-3-9-1	92.61	88.12	85.30	88.68	91.00	89.07	83.98	88.02
GZ 10804-3-1-2-2-2	94.94	91.95	89.64	92.19	93.13	92.65	91.24	92.42
GZ 10631-1-1-2-4	94.40	93.18	92.52	93.38	92.93	91.22	89.22	91.14
GZ 10686-2-1-3-4	95.60	92.39	90.56	92.85	93.84	92.38	90.41	92.21
GZ 10717-3-5-1-1	93.73	86.75	86.13	88.87	92.91	92.20	89.51	91.64
GZ 10778-17-1-6-1	95.73	94.45	92.89	94.36	95.29	94.69	93.28	94.42
GZ 10848-1-2-2-1	94.19	93.25	89.02	92.16	92.75	90.19	85.70	89.55
GZ 9399-4-1-1-2-1-2	93.73	93.65	91.98	93.12	95.08	93.84	90.00	92.97
GRYT-26-17-178	87.72	82.74	83.59	84.68	86.63	84.23	83.63	84.83
GRYT-29-17-178	90.92	87.13	84.85	87.63	89.50	87.83	86.31	87.89
Mean	93.99	91.43	89.15		93.51	91.89	89.57	
Reduction %	-	2.72	5.15		-	1.73	4.21	
LSD at 0.05 Sowing (S): Genotypes (G): S x G:	 0.28 0.60 1.05				 1.17 0.77 1.34			

1.6. 1000-grain weight

Data presented in Table (8) show that 1000-grain weight was highest in Sakha 108 (29.30 and 29.12 g), followed by GRYT-26-178, while the least values of 1000-grain weight were detected with Korea-27 (24.52 and 23.98 g) in the first and second seasons, respectively. Statistical analysis revealed significant differences among the genotypes. On the other hand, sowing dates did not affect significantly on obtained 1000-grain weight. Interaction between genotypes and sowing dates affected significantly on such trait.

Table (8): 1000-grain weight of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	25.24	25.73	26.08	25.69	25.53	26.04	26.63	26.03
Giza 178	21.07	21.50	21.68	21.42	20.83	21.15	21.67	21.21
Giza 179	26.50	26.33	27.00	26.61	25.70	25.87	26.37	25.98
Sakha 108	28.17	29.67	30.07	29.30	28.70	29.30	29.36	29.12
Sakha 106	27.40	27.53	28.50	27.81	26.87	27.33	27.67	27.29
Sakha 107	26.57	28.33	28.80	27.81	27.30	26.67	27.56	27.18
Sakha 109	27.17	27.53	28.87	27.93	26.88	27.96	29.10	27.98
GZ 10333-9-1-1-3	27.00	26.67	27.27	26.98	26.89	26.76	27.05	26.83
Korea 27	23.93	24.45	25.17	24.52	23.55	24.11	24.28	23.98
GZ 10101-5-1-1-1	27.57	28.17	28.60	28.11	26.61	27.23	27.22	27.09
GZ 10598-9-1-5-5	25.50	27.27	28.10	27.79	26.87	27.53	28.33	27.58
GZ 10590-1-1-3-9-1	25.83	25.33	26.17	25.78	26.87	26.20	25.97	26.35
GZ 10804-3-1-2-2-2	24.43	24.73	24.63	24.60	24.70	25.34	24.76	24.93
GZ 10631-1-1-2-4	24.47	23.67	25.17	24.42	24.87	25.68	25.35	25.03
GZ 10686-2-1-3-4	27.03	28.36	29.33	28.24	26.72	27.67	29.10	27.83
GZ 10717-3-5-1-1	24.37	24.54	25.33	24.75	25.21	25.85	25.72	25.59
GZ 10778-17-1-6-1	25.52	26.67	27.18	26.46	26.36	27.32	28.26	27.31
GZ 10848-1-2-2-1	24.47	25.38	26.19	25.35	24.20	25.73	26.67	25.53
GZ 9399-4-1-1-2-1-2	27.09	26.70	27.17	26.99	25.86	26.58	27.47	26.63
GRYT-26-17-178	28.87	28.34	29.40	28.87	29.57	28.68	29.65	29.30
GRYT-29-17-178	30.30	29.73	30.31	30.11	29.33	30.00	30.10	29.81
Mean	26.65	26.57	26.74		26.80	26.56	26.48	
LSD at 0.05 Sowing (S): Genotypes (G): S x G:	 Ns 0.48 0.84				 Ns 0.31 0.54			

1.7. Grain yield

Data in Table (9) present the rice grain yield as affected by genotypes, sowing date and their interactions. Giza179 rice cultivar produced the highest grain yield (4.86 and 4.79 t/fed), followed by Gz10804-3-1-2-2-2 (4.73 and 4.74) and then korea-27 (4.58 and 4.48 t/fed) in the first and second seasons, respectively. However, the least yields were produced by Sakha-107 (3.49 and 3.46 t/fed) in the 2020 and 2021 seasons, respectively. The obtained yields, over the evaluated genotypes, were 4.26, 404 and 3.76 t/fed in the first season, and 4.25, 4.07 and 3.82 t/fed in the second season for the first and second seasons and the three dates of sowing, respectively. Thus, the rice grain yields were reduced by 5.16 and 4.24% in the second sowing date (May 15th) and by 11.74 and 10.12% in the third sowing date (June 1st) in 2020 and 2021 seasons, respectively.

Table (9): Grain yield (t/fed) of different rice genotypes under variable sowing dates.

Genotype	2020				2021			
	May1st	**May15th**	**June1st**	**Mean (t/fed)**	**May1st**	**May15th**	**June1st**	**Mean (t/fed)**
Giza 177	3.81	3.67	3.34	3.61	3.73	3.57	3.32	3.54
Giza 178	4.56	4.39	4.19	4.38	4.73	4.67	4.31	4.58
Giza 179	5.10	4.81	4.67	4.86	5.03	4.79	4.56	4.79
Sakha 108	4.83	4.21	3.67	4.23	4.94	4.29	3.78	4.34
Sakha 106	4.46	3.95	3.86	4.09	4.53	4.11	3.81	4.15
Sakha 107	3.65	3.43	3.38	3.49	3.60	3.53	3.25	3.46
Sakha 109	4.05	3.87	3.74	3.89	3.96	3.87	3.60	3.81
GZ 10333-9-1-1-3	4.54	4.23	3.88	4.22	4.47	4.33	4.10	4.30
Korea 27	4.98	4.75	4.03	4.58	4.89	4.47	4.07	4.48
GZ 10101-5-1-1-1	3.67	3.41	3.29	3.46	3.71	3.78	3.57	3.69
GZ 10598-9-1-5-5	3.81	3.76	3.49	3.69	3.78	3.73	3.62	3.71
GZ 10590-1-1-3-9-1	4.08	3.98	3.53	3.86	3.97	3.89	3.85	3.91
GZ 10804-3-1-2-2-2	5.15	4.86	4.18	4.73	5.31	4.93	3.96	4.74
GZ 10631-1-1-2-4	4.27	4.14	4.02	4.14	4.32	4.23	4.12	4.22
GZ 10686-2-1-3-4	3.63	3.54	3.23	3.47	3.71	3.46	3.37	3.52
GZ 10717-3-5-1-1	3.83	3.68	3.54	3.68	3.91	3.81	3.67	3.79
GZ 10778-17-1-6-1	3.84	3.71	3.69	3.74	3.89	3.78	3.72	3.79
GZ 10848-1-2-2-1	4.75	4.55	3.86	4.39	4.63	4.35	3.89	4.29
GZ 9399-4-1-1-2-1-2	4.55	4.34	4.19	4.36	4.45	4.19	4.12	4.25
GRYT-26-17-178	3.77	3.72	3.42	3.64	3.83	3.73	3.65	3.74
GRYT-29-17-178	4.05	3.93	3.82	3.93	3.92	3.87	3.73	3.84
Mean (t/fed)	4.26	4.04	3.76		4.25	4.07	3.82	
Reduction %	-	5.16	11.74		-	4.24	10.12	
LSD at 0.05								
Sowing (S):	0.04				0.04			
Genotypes (G):	0.08				0.07			
S x G:	0.15				0.13			

2. Insect infestations

2.1. Rice leafminer (*Hydrellia prosternalis* Deem.)

2.1.1. Number of infested leaves/ 100-rice leaves

Data presented in Table (10) revealed significant effects of rice genotypes, sowing dates and the interaction on percentage of infested leaves by rice leaf miner (*Hydrellia prosternalis* Deem.). In 2020 season, Giza 178 was the highest infested (45.67%) followed by Giza 179 (44.89%) and GZ 10778-17-1-6-1 promising line (39.78%), while Sakha 106 was the least infested (11.00%). In 2021 rice season, Giza 178 and GZ 9399-4-1-1-2-1-2 line were the highest infested, while Giza 179 occupied the second rank. According to the category of RRTC (2016), four entries; Sakha 106, GRYT-29-17-178, GZ 10631-1-1-2-4 and GRYT-26-17-178 lines performed as moderately resistant. Out of the 21 rice promising lines, seventeen entries proved to be moderately susceptible, susceptible or highly susceptible to the rice leaf miner. The average infestation significantly increased gradually as the sowing date was later. Maximum percentages of infested leaves were produced by genotypes sown on June 1st, whereas the minimum percentages were recorded in those sown on May 1st. It was noticed that delay of sowing date from May 1st to May 15th increased the infested leaves by the rice leafminer by 17.94 and 27.23%, and delay to June 1st increased the insect infestation by 39.01 and 50.54% in 2020 and 2021 seasons, respectively.

Table (10): Percentage of rice leaves infested with rice leaf miner under variable sowing dates.

Genotype	2020				2021				Over all Mean	Category
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean		
Giza 177	17.33	21.67	28.67	22.56	22.30	27.33	34.33	28.00	25.28	MS
Giza 178	36.33	41.33	59.30	45.67	46.00	57.30	67.70	57.00	51.34	HS
Giza 179	34.67	43.70	56.33	44.89	45.67	49.70	60.30	51.90	48.40	HS
Sakha 108	19.00	24.33	28.30	23.89	17.70	24.33	29.33	23.78	23.84	MS
Sakha 106	9.00	12.33	11.70	11.00	8.67	17.67	21.67	15.00	13.oo	MR
Sakha 107	24.00	27.00	36.00	29.00	21.70	27.33	31.68	26.89	27.95	MS
Sakha 109	24.00	25.67	34.70	28.11	23.00	29.70	36.30	29.67	28.89	MS
GZ 10333-9-1-1-3	15.00	19.33	24.70	19.67	16.33	23.00	24.33	21.23	20.45	MS
Korea 27	31.70	35.67	35.70	34.33	38.30	47.00	56.30	42.22	38.28	S
GZ 10101-5-1-1-1	8.70	12.00	15.33	12.00	18.70	31.00	39.67	29.78	20.89	MS
GZ 10598-9-1-5-5	36.67	29.70	43.00	39.80	48.00	49.33	61.30	52.90	46.35	HS
GZ 10590-1-1-3-9-1	19.33	25.30	30.30	25.00	28.00	39.00	47.30	38.11	31.56	S
GZ 10804-3-1-2-2-2	21.68	24.33	26.00	24.00	26.33	26.33	31.33	28.00	26.00	MS
GZ 10631-1-1-2-4	12.00	17.70	20.30	16.67	14.70	17.33	19.30	17.11	16.89	MR
GZ 10686-2-1-3-4	21.00	24.67	29.00	24.90	28.30	36.00	43.30	35.89	30.40	S
GZ 10717-3-5-1-1	17.33	21.33	24.00	20.90	21.00	27.00	29.33	25.78	23.34	MS
GZ 10778-17-1-6-1	38.33	41.33	39.67	39.78	39.00	44.00	51.00	44.67	42.23	HS
GZ 10848-1-2-2-1	15.00	17.33	22.70	18.33	22.00	35.70	38.68	32.11	25.22	MS
GZ 9399-4-1-1-2-1-2	33.00	37.63	42.67	37.77	44.67	59.33	66.70	56.90	47.34	Hs
GRYT-26-17-178	11.00	15.30	14.33	13.56	19.00	26.30	32.30	25.90	19.73	MR
GRYT-29-17-178	12.67	12.00	13.33	12.67	13.70	21.67	25.33	20.20	16.44	MR
Average	21.79	25.70	30.29		26.81	34.11	40.37			
Increase %	-	17.94	39.01		-	27.23	50.54			
LSD at 0.05 Sowing (S): Genotypes (G): S x G:		 3.98 2.98 5.18					 5.23 5.28 9.15			

Resistant R=0-10%, moderately resistant MR= >10 -20%, moderately susceptible MS=>20-30%, susceptible S= >30-40% and highly susceptible HS= ≥ 40 %. (RRTC, 2016).

2.1.2. Number of mines / 100-rice leaves

Number of mines per 100 rice leaves was significantly affected by rice genotype, sowing date and the interaction as presented in Table (11). In 2020 season, the highest number of mines was recorded in leaves of Giza 178, which is almost the same of Giza 179 (Table 11). In 2021 season, the highest number of mines was found in Korea 27, followed by GZ 9399-4-1-1-2-1-2 rice line and Giza 178 cultivar, while the least was that of Sakha 106 rice cultivar. Means of sowing dates over the genotypes showed that rice sown on 1st of May had the least values of mines per 100 rice leaves, while that sown later suffered the highest values. The second cultivation (May 15th) had higher number of mines compared to the first cultivation; 18.71 and 40.75% increase compared to the first cultivation in the first and second seasons, respectively. The corresponding values of increase in rice leafminer mines were 71.32 and 75.20% in 2020 and 2021 seasons, respectively.

Table (11): Rice leaf miner mines/100 rice leaves under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	33.67	39.00	54.00	42.20	46.33	51.33	67.67	55.11
Giza 178	71.00	77.00	117.70	88.56	74.30	79.67	116.70	90.20
Giza 179	75.33	86.30	98.33	86.67	93.00	82.00	91.00	88.67
Sakha 108	27.70	34.70	51.30	37.90	31.33	52.00	67.33	50.20
Sakha 106	14.33	19.67	23.33	19.11	16.30	33.30	39.33	29.70
Sakha 107	32.00	38.33	60.00	43.40	31.67	44.67	57.70	44.67
Sakha 109	35.00	41.67	58.33	45.00	37.33	16.33	79.67	61.11
GZ 10333-9-1-1-3	19.67	24.70	49.67	31.33	22.33	52.33	59.33	44.70
Korea 27	41.00	44.30	20.00	51.80	77.33	113.00	128.33	106.20
GZ 10101-5-1-1-1	14.70	20.33	26.70	20.56	24.67	59.00	73.30	52.33
GZ 10598-9-1-5-5	47.33	52.67	68.70	56.11	72.33	87.67	102.30	87.40
GZ 10590-1-1-3-9-1	27.00	35.70	69.70	44.11	43.67	104.00	119.30	89.00
GZ 10804-3-1-2-2-2	31.00	41.33	60.67	44.33	46.33	53.00	61.70	53.67
GZ 10631-1-1-2-4	20.00	28.33	41.67	30.00	26.33	31.00	39.30	32.20
GZ 10686-2-1-3-4	36.67	42.67	58.33	45.90	60.00	47.33	68.00	58.40
GZ 10717-3-5-1-1	33.70	40.33	52.33	42.11	35.00	38.67	56.33	43.33
GZ 10778-17-1-6-1	55.67	66.00	83.30	68.33	57.00	78.00	95.70	76.90
GZ 10848-1-2-2-1	36.33	43.00	71.67	50.33	32.00	91.00	109.33	77.40
GZ 9399-4-1-1-2-1-2	55.30	64.33	71.33	63.67	72.33	109.00	127.00	102.80
GRYT-26-17-178	17.70	21.67	39.33	26.20	30.30	34.00	53.00	39.11
GRYT-29-17-178	19.00	21.33	27.00	22.40	19.33	28.67	49.33	32.40
Mean	35.43	42.06	59.70		45.20	63.62	79.19	
Increase %	-	18.71	71.32		-	40.75	75.20	
LSD at 0.05								
Sowing (S):		1.06				9.47		
Genotypes (G):		6.03				9.55		
S x G:		10.54				16.54		

2.2. Rice stem borer (*Chilo agamemnon* Bles.) infestation

2.2.1. Dead heart symptom

Data presented in Table (12) show the rice stem borer infestation, expressed as dead hearts, as affected by rice genotypes and sowing dates in both seasons. Dead hearts differed significantly among the rice genotypes, with GRYT-26-17-178 rice line being the highest infestation, while GZ 10101-5-1-1-1 line recorded the least infestation. In both seasons, dead heart percentages decreased as the sowing date was later. The first cultivation (May 1st) had 6.12% and 6.06% dead hearts, decreased to 4.92 and 4.88% and to 4.30 and 4.12% in the second and third cultivations in 2020 and 2021 seasons, respectively. Thus, the dead heart percentages decreased by 19.61 and 19.47 in the second cultivation, and by 29.74 and 32.01% in the third cultivation in 2020 and 2021 seasons, respectively.

Table (12): Dead heart percentage due to rice stem borer under variable sowing dates.

Genotype	2020				2021			
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean
Giza 177	3.16	2.71	2.49	2.79	2.60	2.30	2.07	2.32
Giza 178	8.45	6.18	5.89	6.85	7.84	5.98	4.20	6.01
Giza 179	7.97	5.42	5.52	6.30	6.31	5.91	5.13	5.65
Sakha 108	2.51	2.28	3.15	2.65	2.30	2.14	1.62	2.82
Sakha 106	3.51	3.18	3.07	3.25	4.18	3.38	2.60	3.39
Sakha 107	3.60	2.94	2.72	3.10	2.45	2.27	3.04	2.59
Sakha 109	3.45	3.34	2.44	3.10	3.40	2.96	2.95	3.10
GZ 10333-9-1-1-3	3.17	2.56	3.43	3.05	3.23	2.88	3.21	3.11
Korea 27	8.65	7.32	7.30	7.76	10.15	8.05	6.25	8.15
GZ 10101-5-1-1-1	2.85	7.37	2.92	2.71	8.57	2.15	1.55	2.09
GZ 10598-9-1-5-5	7.49	6.48	3.98	5.98	7.81	4.85	4.81	5.82
GZ 10590-1-1-3-9-1	9.87	7.19	3.73	6.93	6.84	6.42	5.14	6.13
GZ 10804-3-1-2-2-2	4.98	3.71	3.23	3.97	5.12	4.08	3.52	4.23
GZ 10631-1-1-2-4	3.26	2.71	2.24	2.74	2.24	2.16	2.18	2.20
GZ 10686-2-1-3-4	3.22	2.94	3.22	3.13	3.30	2.67	1.95	2.64
GZ 10717-3-5-1-1	2.92	2.73	2.70	2.79	3.75	3.36	4.37	3.83
GZ 10778-17-1-6-1	6.89	5.63	6.46	6.33	8.16	6.81	5.10	6.69
GZ 10848-1-2-2-1	8.87	6.21	5.74	6.95	10.28	8.10	6.67	8.35
GZ 9399-4-1-1-2-1-2	10.28	8.33	6.15	8.26	9.91	9.12	5.75	8.25
GRYT-26-17-178	9.94	8.29	6.74	8.32	11.17	9.80	8.15	9.71
GRYT-29-17-178	9.47	7.74	6.19	7.81	11.73	8.53	6.23	8.83
Mean	6.12	4.92	4.300		6.06	4.88	4.12	
Reduction %	-	19.61	29.74		-	19.47	32.01	
LSD at 0.05								
Sowing (S):		0.45				1.02		
Genotypes (G):		1.18				0.95		
S x G:		2.04				1.65		

2.2.2. White head symptom

Data presented in Table (13) show the susceptibility of rice genotypes to rice stem borer, *C. agammnon* expressed as white heads. The highest infested genotypes were GRYT-29-17-178, GRYT-26-17-178 and GZ9399-4-1-1-2-1-2. However, the least infested genotypes were Giza 177, Sakha 107 and GZ 10101-5-1-1-1. According to the category of RRTC (2016), the seven commercial cultivars; Sakha 107 and Giza 177 performed as resistant, Sakha 106, 108 and 109 as moderately resistant, while Giza 178 and 179 performed as moderately susceptible. Only two entries; GRYT-26-17-178 and GRYT-29-17-178 were estimated as susceptible. Out of the 21 rice promising lines, twelve entries proved to be resistant, moderately resistant and moderately susceptible to the rice stem borer. The infestation by rice stem borer significantly decreased gradually as the sowing date was later. Maximum percentages of white heads were produced by genotypes sown on 1st of May, whereas the minimum were those sown on June 1st. The reductions in white heads were 23.77 and 21.11 in May 15th cultivation, and were 34.44 and 35.04% in June 1st cultivation in 2020 and 2021 seasons, respectively.

Table (13): White head percentage due to rice stem borer under variable sowing dates.

Genotype	2020				2021				Over all Mean	Category
	May1st	May15th	June1st	Mean	May1st	May15th	June1st	Mean		
Giza 177	2.94	2.52	2.20	2.56	3.44	3.16	2.88	3.16	2.86	R
Giza 178	8.49	5.67	5.26	6.47	8.51	7.16	6.26	7.31	6.89	MS
Giza 179	8.36	6.41	5.38	6.71	7.73	7.08	5.22	6.68	6.70	MS
Sakha 108	3.51	3.20	2.96	3.22	3.67	2.82	2.25	2.91	3.07	MR
Sakha 106	4.08	3.30	2.68	3.35	4.54	3.63	1.41	3.19	3.27	MR
Sakha 107	3.63	3.25	2.44	3.11	3.75	2.53	2.13	2.81	2.96	R
Sakha 109	4.34	3.18	2.89	3.47	4.48	3.70	2.68	3.62	3.55	MR
GZ 10333-9-1-1-3	4.15	3.35	2.62	3.37	4.58	3.46	2.81	3.63	3.50	MR
Korea 27	9.81	8.08	6.75	8.21	11.07	9.34	8.89	9.77	8.99	MS
GZ 10101-5-1-1-1	3.60	2.92	2.32	2.95	4.59	3.57	2.84	3.67	3.31	MR
GZ 10598-9-1-5-5	8.93	6.38	3.92	6.41	9.04	6.33	5.88	7.09	6.75	MS
GZ 10590-1-1-3-9-1	9.58	6.59	6.44	7.54	7.89	5.87	5.16	6.31	6.93	MS
GZ 10804-3-1-2-2-2	5.52	3.73	3.63	4.29	4.96	3.69	3.39	4.01	4.15	MR
GZ 10631-1-1-2-4	4.10	2.96	2.76	3.27	3.16	2.17	1.29	2.21	2.74	R
GZ 10686-2-1-3-4	4.04	2.43	2.64	3.04	3.79	2.70	2.36	2.95	3.00	R
GZ 10717-3-5-1-1	3.52	3.39	3.01	3.31	4.23	3.59	1.92	3.25	3.28	MR
GZ 10778-17-1-6-1	9.23	6.95	4.60	6.93	8.79	6.03	5.93	6.92	6.93	MS
GZ 10848-1-2-2-1	8.64	7.13	4.81	6.86	9.23	8.03	6.53	7.73	7.30	MS
GZ 9399-4-1-1-2-1-2	10.47	8.01	5.59	8.03	8.67	5.81	4.75	6.41	7.22	MS
GRYT-26-17-178	10.82	7.25	6.37	8.15	12.39	9.84	8.76	10.32	9.24	S
GRYT-29-17-178	10.40	8.06	7.07	8.51	11.73	10.22	8.73	10.23	9.37	S
Mean	6.73	5.13	4.21		6.82	5.38	4.43			
Reduction %	-	23.77	34.44		-	21.11	35.04			
LSD at 0.05 Sowing (S): Genotypes (G): S x G:			 1.07 0.99 1.87				 0.18 0.66 1.39			

Resistant R= 0 -3%, Moderately resistant MR= > 3 -6%, Moderately susceptible MS= > 6-9 %, Susceptible S= > 9-12 % and Highly susceptible HS= > 12 % (RRTC, 2016).

2.3. Correlation coefficient value between dead hearts and white heads

The correlation coefficient value between average of dead hearts and average of whit heads were computed as highly significant positive (r= 0.988**). This means that both symptoms of rice stem borer infestation were almost in parallel in the vegetative and reproductive stages.

DISCUSSION

Rice is an important element of agricultural income of about 114 countries all over the world, including Egypt. Thus, defects of such crop production negatively affect the income of the growers (FAO STAT 2021). There are several factors affect the ideal rice productivity (Zayed *et al* 2014), from which is the appropriate sowing date. Farrell *et al* (2003) summarized the necessity of growing rice at suitable time in the following items: 1) growth stage occurs at temperatures and solar radiations relevant to optimum tillering, 2) plant each genotype at suitable temperatures of daytime and nighttime, and 3) suitable planting time guarantees that grain filling coincides optimum environmental conditions, which reflect good grain quality.

In the current study, the greatest values of flag leaf area, number of panicles/ hill, panicle weight, number of grains per panicle, and grain yield were significantly highest in May 1st cultivation, but lowest in June 1st cultivation. Tashiro *et al* (1999) reported a good seedling establishment when planting rice at early sowing date, to ensure an appropriate temperature during seed germination at seedling emergence. Metwally *et al* (2012) found that rice plants sown on May 1st surpassed those grown on June 1st in most of rice plant characters considered in our investigation. Osman (2019) obtained results in the same line, when 14 rice genotypes were evaluated at the experimental farm of Rice Research and Training Center, Sakha, Egypt. When the environmental conditions are favorable for rice growth, number of panicles per hill was higher in earlier than in later sown rice (Dawadi and Chaudhary, 2013), the same trend was proven by El-Malky and El-Zun (2014).

The solar radiation is a highly effective factor in forming efficient leaf area and in accumulation of starch, thus, the rice plants can produce more productive tillers, and higher number of grains per panicle (Sridevi and Chellamutha 2015). Records of Meteorological Station, Water, Soil and Environmental Institute, Egypt (Table 2) show that optimum temperature and solar radiation coincided with vegetative growth of rice, in the current research. This explains why the early cultivation of rice produced higher parameters than the late cultivation. Wani *et al* (2018) concluded that optimum sowing date ensures that seedling growth will be better as affected directly by soil and air temperature, which encourages good plant stand and favorable conditions for greater leaf area and high photosynthesis that accumulates higher amounts of starch. Rajpoot *et al* (2019) concluded that the adjustment of planting date is an important factor that enhances rice grain yield, and reduce the risks of pests in delayed sown rice.

One of the biotic stresses on rice plants is the insect infestation. In Egypt, the two major insect pests are rice leafminer, *Hydrellia prosternalis* Deem., and rice stem borer, *Chilo agammnon* Bles. (Sherif 2002 and Sherif *et al* 2005). In the current investigation, *H. prosternalis* infestation was found high as the rice sowing was later; 21.79, 25.70 and 30.29% infested leaves in the first season, and 26.81, 34.11 and 40.37% in the second one, in May 1st, May 15th and June 1st cultivations, respectively. It was found that late rice sowing coincides with a high peak of adult activity, and in the same time, the rice seedlings are still succulent, which exposes the rice plants to stress of infestation (El-habashy 2011). Shalaby (2018) recorded higher rice leafminer infestation in June 1st cultivation (9.5%) than in May 1st cultivation (6.4 %). However, the early rice sowing allows the plants a chance to avoid high rice leafminer population, and thus, the plants escape the severe infestation (Taha *et al*. 2021).

The rice stem borer, *Chilo agammnon* Bles. was always considered the major insect, in Egypt, for several decades (Sherif *et al* 1997). Sherif (1979) found that the early rice plantations (the first half of May) suffered less rice stem borer infestation than the latest ones. However, since about 10 years ago, the insect infestation status was reversed. This may be due to the release of early maturing rice varieties which enforced the insect to alter its behavior to catch the early grown rice varieties, which are harvested by late August or early September instead of harvesting by late September or early October. Accordingly, the current study revealed higher dead hearts and white heads in early cultivation than in late one. However, Rajpoot *et al.* (2019) concluded that the adjustment of rice planting late is the most practical way to inhibit rice stem borer (*Scirpophaga incertulas* Walker) infestation, as well as release of insect-resistant rice varieties.

Tetarwal *et al* (2014) indicated that stem borers are globally controlled by insecticides, and about 50% of all insecticides applied in rice fields are directed to rice stem borer control. In general, both insecticides and biological control are difficult to adopt against rice stem borers because the insect larvae live mostly inside rice stems, and the adult activity in nocturnal.

One of the major tasks of rice breeders in producing new cultivars that resist, even partially, the attacks of stem borers. Thus, the breeders emphasize selection for insect resistant rice varieties (Khan 2005). This strategy is in line with evaluation of the 21 rice genotypes to rice stem borer in Egypt. We found that several evaluated genotypes were resistant or moderately resistant to the borer. This approach is more practical than applying insecticides.

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تأثير ميعاد الزراعة علي المحصول ومكوناته لبعض تراكيب الأرز الوراثية والإصابة بصانعات أنفاق أوراق الأرز(*Hydrelliaprosternalis* Deem.) وثاقبات ساق الأرز (*Chilo agammnon* Bles.)

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الملخص العربي

أجريت تجربة حقلية في المزرعة البحثية لقسم بحوث الأرز- سخا- كفر الشيخ خلال موسمي الأرز(٢٠٢٠- ٢٠٢١) بهدف دراسة تأثير ثلاث مواعيد زراعة (١ مايو ، ١٥ مايو، ١ يونيو) علي المحصول ومكوناته لعدد ٢١ تركيب وراثى من الأرز وكذلك درجة مقاومتها للإصابة بصانعات أنفاق أوراق الأرز (*Hydrellia prosternalis* Deem.) وثاقبات ساق الأرز(*Chilo agammnon* Bles.). وقد أوضحت أهم النتائج المتحصل عليها أن مواعيد الزراعة قد أثرت تأثيرا معنويا علي كل الصفات المدروسة في كلا الموسمين، حيث سُجلت أعلي القيم في مساحة ورق العلم، عدد السنابل في الجورة، وزن السنبلة، عدد الحبوب الكلي في السنبلة، النسبة المئوية للحبوب السليمة، وزن الألف حبة ومحصول الحبوب للفدان عند زراعة الآرز مبكرا (١ مايو), بينما سُجلت أقل القيم في حالة الزراعة المتأخرة (١ يونيو). أظهر التحليل الإحصائي للتراكيب الوراثة للأرز وجود اختلافات معنوية لكل الصفات المدروسة في كلا موسمي الزراعة. هذا وقد حقق الصنف جيزة ١٧٩ والسلالة GZ 10804-3-1-2-2-2, تلاهما الصنفين جيزة ١٧٨ وسخا ١٠٨ أعلى قيم لمعظم الصفات المحصولية.

زادت نسبة الإصابة بصانعات أنفاق أوراق الأرز تدريجيا كلما تأخر ميعاد الزراعة ، كما أخذت النسبة المئوية للأنفاق ١٠٠ ورقة أرز نفس الإتجاه. سجلت أعلي نسبة إصابة بصانعات أنفاق أوراق الآرز وكذا النسبة المئوية للأنفاق ١٠٠ ورقة أرز في الصنفين جيزة ١٧٨ , وجيزة ١٧٩, تلاهما السلالتين GZ 9399-4-1-1-2-1-2 **,** GZ 10778-17-1-6-1. اشتدت الإصابة بثاقبة ساق الآرز من خلال مظهري الإصابة, القلوب الميتة والسنابل البيضاء في حالة الزراعة المبكرة (١ مايو) وانخفضت تدريجيا بتأخير ميعاد الزراعة الي (١ يوليو). السلالات GRYT-26-17-178, GRYT-29-17-1178, Korea27 سجلت أعلي متوسطات لنسبة الإصابة بالقلوب الميتة والسنابل البيضاء خلال موسمي الزراعة.