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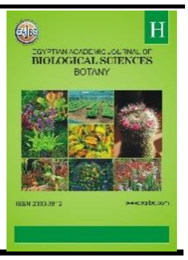

Influence of Sowing Dates and Nitrogen Fertilization Levels on Rice Yield and Insect Infestation of Sakha Super 300 Rice Cultivar

Taha, A. S.[1], H. A. Saleh[2] and Eman M. Bleih[1]
1-Rice Res. Dept., Field Crops Res. Inst., Agric. Res. Center, Egypt.
2-Field Crop Pests Res. Dept., Plant Prot. Res. Inst., Agric. Res. Center, Egypt.
*****E-Mail :hosamsom@yahoo.com

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ABSTRACT

Field experiments were conducted at the Experimental Farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt, during 2019 and 2020 rice growing seasons. The objectives were to investigate the effect of three sowing dates (May 1st, June 1st and July 1st) and four levels of nitrogen fertilizer (0, 46, 69 and 92 kg /fed.) on rice yield and the infestation by rice leaf miner, *Hydrellia prosternalis* Deem. and rice stem borer, *Chilo agammnon* Bles. in Sakha Super 300 rice cultivar. Plant height, days to heading, filled grains/panicle, panicle weight, 1000-grain weight and grain yield were higher as rice was planted earlier, in both seasons. The number of panicles per hill was highest at June 1st planting. Also, fertility % was highest at June 1st plantation, but lowest at May 1st plantation. Values of all traits increased by the increase in nitrogen level, with the exception of fertility and 1000-grain weight. Rice leaf miner infestation increased gradually as the rice was planted later. The numbers of infested leaves were 21.80 and 23.42 per 100 rice leaves when planting on May 1st. The infestation was highest with corresponding values of 44.45 and 46.00 per100 rice leaves in 2019 and 2020 seasons, respectively. Percentages of mines took the same trend. Also, the percentages of infested leaves and mines were higher by increasing the dose of nitrogen fertilization. Averages of dead hearts, caused by the rice stem borer were 7.2, 6.6 and 4.6 %, and those of whiteheads were 7.9, 6.6 and 4.8 % for May 1st, June 1st and July 1st plantations, respectively. As for nitrogen levels, it was clear that the borer infestation gradually increased, as dead hearts and whiteheads, due to an increase in nitrogen level. Thus, it is recommended to sow rice early (during May) with moderate nitrogen levels (69 kg N/fed.) to avoid severe infestations by rice leaf miner and rice stem borer.

INTRODUCTION

Rice occupies one-third of the world’s area specified for cereal production and is considered a staple food for more than one-half of the world's population, who depend on it as a main daily source of calories and protein (Tiwari *et al*., 2014). In Egypt, rice is the second staple food, after wheat, and is very important for local consumption as well as for export. It is cultivated annually in about one million feddans, mostly in the Northern part of

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the Nile Delta. Rice productivity in Egypt may be the highest all over the world, with an average of about 4 tons per feddan (Shalaby 2018).

Adjustment of the planting date becomes very important under climate change issues. Metwally *et al. (*2016) noticed that early sowing on the 10th of April of some Egyptian rice genotypes has produced better yield and yield attributes compared to late sowing dates (later than mid-May). Modifying sowing dates directly impacts both the photo and thermo period, and consequently has a good influence on dry matter accumulation (Patel *et al*., 2019). The planting date affects the efficiency of rice genotypes in exploiting the environmental resources, consequently, the selection of optimum planting date is very important for obtaining the highest productivity (Ali and Rahman 1992). Delaying planting date reduces the chlorophyll content, leaf area index and dry matter production, which reflects low yield (El-Khoby, 2004).

Nitrogen is the most essential mineral nutrient for plant growth and development, and proper nitrogen management is essential in intensive agriculture for plant production. However, if there is a continuous increase in nitrogen application, the uptake rate tends to fall rapidly with no further increase in yield. It has been noted that excessive nitrogen application causes higher vegetative growth with lower harvest index, plant lodging and susceptibility to diseases and insect pests (Lu *et al*., 2007). Djamin *et al*. (2018) used six nitrogen rates (0, 60, 90, 120, 150 and 180kg N/ha) in fertilizing hybrid rice, and found that the fertilization rate of 150 kg was the best rate for obtaining the highest grain yield compared to other fertilization rates.

Rice plants are liable to attack by more than 100 insect species; about 20 of which result in economic damage. In Egypt, rice plants are injured by several insect pests, with only two species; the rice stem borer, *Chilo agamemnon* Bles. and rice leaf miner, *Hydrellia prosternalis* cause economic yield losses (Sherif *et al*., 2005). Rice leaf miner results in considerable yield losses in rice sown later than mid-May, and the plants are still susceptible to economic infestations up to four weeks after transplanting (Sherif *et al*., 2005). Rice yield losses, due to the stem borer, *Chilo agamemnon*, were estimated as 8-10% depending on rice cultivar (Sherif 1996). Stem borers larvae live in rice stems, resulting in two symptoms of damage. During the vegetative stage, the larvae kill the central shoots resulting in a "dead heart" and thus the tillering is reduced. During the reproductive stage, the larvae feed inside the shoots directly under the panicle which becomes empty with no filled grains, and appear as white panicles called "whiteheads". The latter symptom is more responsible for yield losses than the former one because rice plants can not compensate for whiteheads. Chaudhari *et al.* (2018) concluded that rice sowing at different dates did not significantly the rice stem borer infestation. Shalaby (2018) found high rice infestation by rice leaf miner and rice stem borer at late planting, while the early planting helped the crop to avoid high insect infestations and increased rice yield. Suharto and YSyati (2005) tested the rice infestation by stem borer (*Scirpophaga inceretualas* WLK.) at three planting dates; normal date of the planting, two weeks before and two weeks after. The borer infestation was higher at the earliest planting date compared to the second and third plantings. Rice yields correlated with planting time but did not correlate with the borer infestation. Baruah and Dutta (2020) found that early sown rice (15th May) was least damaged by rice stem borer; 9.6% dead heart (DH) and 10.3% white head (WH) as compared to normal (5th June) with 15.5% DH and 16.7% WH. The highest infestation (24.6% DH and 25.3%WH) was found with the latest planting (25th June). Fallah *et al.* (2019) recommended using 60 kgN/ha to avoid severe infestation with the rice stem borer, as the rate of 90 kgN/ha induced high infestation with the insects. Rajpoor *et al.* (2019) investigated the effect of rice sowing dates on rice stem borer, *Scirpophaga inertuales* Walker, infestation. The pest incidence was highest at the early sown rice (1st July), decreased on rice sown in mid-July, but least at late sown rice (31th July). On the other hand, the highest yield was obtained with the earliest sowing date.

The current study aimed to investigate the effect of sowing date and nitrogen fertilizer rates on yield and insect infestations of Sakha Super 300 rice cultivar.

MATERIALS AND METHODS

Field experiments were conducted at the Experimental Farm of Rice Research and Training Center (RRTC), Sakha, Kafer El-Sheikh, Egypt, during 2019 and 2020 rice growing seasons. The experiments aimed to investigate the effect of three sowing dates (May 1st, June 1st and July 1st) and four levels of nitrogen fertilizer (0, 46, 69 and 92 kg /fed.) on yield and yield attributes and the infestation by rice leaf miner (*Hydrellia prosternalis* Deem.) and rice stem borer (*Chilo agammnon* Bles.). Sakha Super 300 was the tested rice cultivar, and the preceding crop was wheat.

A split-plot design was applied, where the sowing dates were laid out in the main plots, and the nitrogen levels were laid out in the subplots. Seeds of rice cultivar Sakha Super 300 at the rate of 60 kg/ fed., were soaked in freshwater for 24 hr, and incubated for 48 hr to hasten germination and then, were broadcasted in the nursery. Seedlings of 30 days old were transplanted (3 seedlings $hill^{-1}$) at 20 x 20 cm distance between hills and rows. The area of the experimental plot was 15 m^2 (3 m x 5 m). The nitrogen fertilizer was added in the form of urea (46.5 % N) in three splits according to the determined nitrogen level applied; 1/3 as basal (incorporated into the soil before puddling), 1/3 twenty days after transplanting, and the last third was added at forty days after transplanting for each sowing date. Five days after flooding, the transplanted field was treated with herbicide; thiobercarb (Saturn 50%) at the rate of 2L/fed. to control weeds. All identical agricultural managements were done as the recommendations of Rice Research and Training Center.

Evaluation of Yield and Yield Attributes:

Days to complete heading were recorded for each treatment. Five hills were randomly selected from each plot to estimate the plant height (cm), and the number of panicles/hill. Ten panicles were randomly collected to estimate the panicle weight (g), total filled grains /panicle, fertility % and 1000-grain weight (g). An area of 6 m^2 in the center of each plot was manually harvested at full maturity, dried and threshed, and then the grain yield was recorded. Net grain yield was modified at 14% moisture content.

Evaluation of Insect Infestation:

Rice Leaf Miner, ***Hydrellia prosternalis*** **Deem.:**

Twenty-five days after transplanting, 100 rice leaves were picked from each plot, and the infested leaves and the number of mines were counted.

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

Forty days after transplanting, the plants were examined to the dead heart symptom. From each plot, five random hills were cut at the soil surface. The total number of tillers and those of dead hearts were counted, thus, the dead heart percentage was calculated.

Three weeks prior to harvest, white head percentages were estimated. Five hills/plots were cut at the soil surface, the total number of tillers and those having whiteheads were recorded, and thus, the white head percentage was calculated.

Statistical Analysis:

Data were subjected to the standard statistical analysis with COSTAT. The significantly different means were compared using Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSION

The effect of sowing date, nitrogen fertilizer level and their interaction on plant height, days to heading and number of panicles per hill and the total number of grains per panicle are given in Table (1). The highest values of plant height and days to heading were obtained with the earliest (May1st) sowing date in both seasons, while the second sowing date (June1st) gave the highest values for the number of panicles per hill. Total filled grains /panicle was higher at first and second sowing dates without any significant differences between them. The lowest values of plant height, days to heading and number of panicles per hill and the total number of grains per panicle were obtained with the latest sowing date (July1st) in both seasons. The results are in harmony with those obtained by Metwally *et al.* (2016). Sedeek *et al.* (2009) indicated that the growth duration exhibited an increasing trend of early planted crops and decreasing trend of late-planted ones. Abo Youssef *et al.*(2005) showed that early sowing dates increased plant height.

Table 1: Effect of sowing date and nitrogen level on plant height, days to heading, number of panicles /hill and total grains /panicle of Sakha Super 300 rice cultivar

Treatment	Plant height (cm)		Days to heading		No. of panicles / hill		Total No. of grains /panicle	
	2019	2020	2019	2020	2019	2020	2019	2020
Sowing date(S)								
May 1st	116.13a	113.92a	115.42a	114.3a	22.70 b	22.41b	166.36a	160.9 a
June 1st	106.36b	106.42b	94.75 b	94.50 b	23.82 a	23.08a	170.51a	163.5 a
July 1st	95.37c	97.98c	76.83 c	77.50 c	19.37 c	19.05c	139.02b	136.7 b
F test	**	**	**	**	**	**	**	**
N level (kg/fed)								
0	99.75d	99.18d	91.90 d	91.33 d	19.57 d	18.52c	135.2 c	134.2 d
46	105.31c	105.17c	94.45 c	93.90 c	21.96 c	21.46b	165.5ab	159.9 b
69	107.61b	108.60b	96.45 b	96.78 b	23.49 a	23.17a	170.4 a	165.9 a
92	111.07a	111.42a	99.91 a	99.79 a	22.81 b	22.89a	163.3 b	154.6 c
F test	**	**	**	**	*	**	**	**
Interaction SXN	*	**	**	**	**	**	**	**

*, ** and NS indicate P <0.05, P<0.01 and not significant, respectively.
In the same column, means followed by the same letter are not significantly different at a 5% level of probability according to DMRT.

The variation in nitrogen fertilization levels induced highly significant differences in plant height, days to heading and number of panicles per hill and the total number of grains per panicle (Table 1). The highest values of plant height and days to heading were obtained with application of 92 kg N/ fed. in both seasons, while the highest values of the number of panicles per hill and total grains /panicle were obtained at 69 kg N/fed., without significant differences between 92 kg N/fed. in 2020 season. On the other hand, the lowest values of plant height, days to heading and number of panicle per hill and the total number of grains were found for the control treatment (without nitrogen fertilizer application) in both seasons.

The increase in plant height with increasing nitrogen levels could be explained by the fact that the increase in plant height is a result of enlarging the internodes. These results are in harmony with those reported by Gorgy (2010). Aslam *et al*. (2015) reported that nitrogen plays a key role in rice production as it is necessarily required. It is the essential component of cell molecules including chlorophyll, nucleic acids, amino acids, ATP and several plant hormones, and this is an important regulator involved in many biochemical processes.

The interaction between sowing date and nitrogen fertilization levels had a highly significant effect on plant height, days to heading, and the number of panicles per hill as presented in Table **(2)**. The highest values of plant height and days to heading were detected in May 1st, when fertilized with 92 kg N/fed., while the lowest was found in July1st, without nitrogen in both seasons. Moreover, the highest panicles per hill were obtained at June1st planting, when fertilized by 69 kg N/fed., in the first and second seasons. The lowest numbers of panicles per hill were found at July1st sowing date, without nitrogen application. Total grains /panicle increased by the application of either 46 or 69 kg N/fed., at first and second sowing dates. Iqbal *et al.* (2008) reported that, regardless of varieties, the number of days to heading and maturity increased significantly by increasing the rates of nitrogen fertilization, as well as the increase in vegetative growth, which caused a delay in heading and maturity of the crop by increasing nitrogen fertilization.

Data presented in Table (3) revealed significant differences in panicle weight, 1000-grain weight and grain yield due to sowing dates. The highest values of panicle weight and grain yield were obtained from the second sowing date (June1st) but without significant differences with the first sowing date (May1st) in both seasons. The earliest sowing date produced a higher value of 1000-grain weight in the first and second seasons. The lowest values of panicle weight, 1000-grain weight and grain yield were found in July1st plantation in both seasons.

Table 2: Plant height, days to heading, number of panicles/ hill and Total grains/ panicle of Sakha Super 300 rice cultivar as affected by the interaction between sowing dates and nitrogen fertilizer levels

Sowing date	**2019**				**2020**			
	Nitrogen levels kg N/fed							
	0	**46**	**69**	**92**	**0**	**46**	**69**	**92**
Plant height (cm)								
May 1st	107.3c	115.2b	118.4b	123.6a	105.5e	113.6c	116.6b	120.0a
June 1st	100.2d	106.5c	107.9c	110.6c	98.7i	104.3f	109.6d	113.1c
July 1st	91.63f	94.27ef	96.6de	98.97d	93.4k	97.6j	99.8h	101.2g
Days to heading (day)								
May 1st	109.3d	113.7c	116.3b	122.3a	110.0d	112.7c	115.4b	119.3a
June 1st	91.7h	93.7g	95.3f	98.3e	90.30h	92.7g	96.3f	98.70e
July 1st	74.7l	76.0k	77.7j	79.0i	73.70l	76.4k	78.7j	81.40i
No. of panicles/ hill								
May 1st	20.40f	22.57d	24.53b	23.33c	19.40g	22.33e	24.53b	23.39d
June 1st	21.33e	23.73c	25.60a	24.60b	19.70g	23.28d	25.35a	24.00c
July 1st	16.97h	19.57g	20.33f	20.61f	16.47i	18.80h	19.63g	21.33f
Total grains /panicle								
May 1st	136.3d	176.4ab	182.4a	170.4b	138.3c	169.7a	176.6a	158.9b
June 1st	144.8cd	179.7 a	181.6a	176.0ab	142.3c	172.4a	179.3a	159.8b
July 1st	124.6e	140.6cd	147.3c	143.6cd	121.9d	137.7c	141.8c	145.2c

Means followed by the same letter are not significantly different at the 5 % level.

Delaying sowing dates from May 1st to June 1st or July 1st caused a significant increase in fertility percentage in both seasons. Sarkar and Reddy (2006) indicated that planting rice varieties sensitive to photoperiod earlier than recommended results in lodging, increase in unfilled grain and decrease in grain yield. On the other hand, in the case of delaying planting beyond the recommended date, a shortage of vegetative growth period leads to a reduction in the yield and its components. Mewally *et al*. (2016) concluded that planting rice after the first of June; the period of vegetative growth shortens, leading to a decrease in the number of effective tillers, a decrease in carbohydrates and nutrients transported to the panicle.

Data presented in Table (3) show that the variation in nitrogen fertilization levels induced highly significant differences in panicle weight, 1000-grain weight, and grain yield t/fed., in the first and second seasons. The highest values of panicle weight and grain yield t/fed. were found in rice plots fertilized with 69 kg N/fed., followed by those fertilized with 46 kg N/fed., but without significant difference between the two treatments during the two growing seasons. This trend might be due to the role of nitrogen in crop maturation, flowering and fruiting including seed formation (Sachiko *et al.*, 2009). Djamin *et al.* (2018) used six nitrogen rates (0, 60, 90, 120, 150 and 180kg N/ha) in fertilizing hybrid rice.

Table 3: Effect of sowing date, nitrogen level and their interaction on panicle weight, fertility percentage, 1000-grain weight and grain yield t/fed. of Sakha Super 300 rice cultivar

Treatment	Panicle weight (g)		Fertility %		1000-grain weight (g)		Grain yield (t/fed)	
	2019	2020	2019	2020	2019	2020	2019	2020
Sowing date (S)								
May 1st	4.57 b	4.52 a	95.8 b	94.57 b	28.70 a	29.13 a	4.63 a	4.42 b
June 1st	4.77 a	4.64 a	96.37 a	95.30 a	28.30 b	28.38 b	4.57 a	4.53 a
July 1st	3.44 c	3.37 b	96.40 a	95.10 a	27.46 c	27.61 c	3.47 b	3.55 c
F test	**	**	**	*	**	**	**	**
N level kg/fed (N)								
0	3.43 c	3.32 d	97.08 a	95.72ab	27.59 c	28.10 c	3.37 c	3.26 c
46	4.60 a	4.50 b	97.14 a	96..08a	29.10 a	29.32 a	4.43 ab	4.48 a
69	4.69 a	4.63 a	96.25 b	95.33 b	28.67 b	28.65 b	4.67 a	4.57 a
92	4.33 b	4.25 c	94.38 c	93.32 c	27.27 d	27.42 d	4.42 b	4.36 b
F test	*	**	**	**	**	**	**	**
Interaction SXN	**	**	*	**	ns	ns	**	**

*, ** and NS indicate P <0.05, P<0.01 and not significant, respectively.
In the same column, means followed by the same letter are not significantly different at a 5% level of probability according to DMRT.

They found that the fertilization rate of 150 kg was the best rate for obtaining a better grain yield compared to other fertilization rates. Increasing nitrogen fertilizer rates from 0 to the highest rate reduced fertility percentage gradually. The highest values of 1000-grain weight were recorded in rice plots fertilized with 46 kg N/fed., on the other hand, the lowest values were found in rice plots fertilized by 92 kg N/fed. in both seasons. The application of nitrogen significantly reduced the 1000-grain weight. This is mainly due to the higher number of spikelets per panicle in plants that received nitrogen at a higher rate than those under a lower nitrogen rate. So, the sink capacity is high and the source is limited, therefore, the filling of grain will be improved consequently the weight of grains will be high. Similar results were obtained by Metwally *et al.* (2011) and Metwally (2015).

The interaction between sowing dates and nitrogen fertilization levels had a highly significant effect on grain yield t/fed. and panicle weight (g) as shown in Table (4). The two best combinations were sowing on May1st or June1st with 69 kg N/fed. which produced the highest grain yield, followed by 46 kg N/fed. with the same sowing dates. On the other hand, the combination of July1st plantation without nitrogen gave the lowest panicle grain weight.

In 2019 season, the highest fertility percentage was at the second planting date combined without nitrogen, while in 2020 season, the second planting date combined with 46 kg N/fed gave the highest fertility percentage

Table4: Panicle weight, fertility percentage and grain yield t/fed. of Sakha Super 300 rice cultivar as affected by the interaction between sowing dates and nitrogen levels

Sowing date	2019				2020			
	Nitrogen levels kg N/fed							
	0	46	69	92	0	46	69	92
Panicle weight (g)								
May 1st	3.52 c	5.09 a	5.07 a	4.61 b	3.48 d	5.03 a	5.07 a	4.49 c
June 1st	3.90 c	5.13 a	5.16 a	4.89 ab	3.69 d	5.06 a	5.11 a	4.71 b
July 1st	2.86 d	3.58 c	3.85 c	3.48 c	2.79 e	3.43 d	3.70 d	3.55 d
Fertility %								
May 1st	96.4b	97.2ab	95.7 c	94.2 d	94.8 d	95.8 b	95.0cd	92.6 f
June 1st	97.5a	97.4 ab	96.5 ab	94.0 d	95.1cd	96.8 a	95.6 b	93.7 e
July 1st	97.1ab	96.9 ab	96.6 ab	95.0 c	95.7 b	95.7 b	95.3cd	93.6e
Grain yield(t/fed)								
May 1st	3.49 e	4.86 c	5.15 a	4.77 c	3.37 g	4.65 c	5.03 a	4.72 bc
June 1st	3.62de	4.95 bc	5.07 ab	4.89 c	3.47 fg	4.86a-c	4.95ab	4.75 bc
July 1st	2.96 f	3.48 e	3.77 d	3.63 de	2.92 h	3.93 d	3.72 e	3.63 ef

Means followed by the same letter are not significantly different at the 5 % level.

Insect infestation:-

Rice leaf miner, *Hydrellia prosternales* Deem.

Data in Table (5) show that, in general, the infestation by the rice leaf miner was higher in the second season than in the first one. As affected by the sowing date, the infestation, during the two seasons, ranged between 21.8 and 46.0 % infested leaves (Table 5). The average infestation increased gradually as the sowing date was later. The least average of leaf infestation (22.6%) was recorded in May 1st plantation, increased to 32.6 and 45.2% in June 1st and July 1st plantations, respectively. The same trend was found with the mines caused by the insect in rice leaves. The least average number (32.6 mines/100 rice leaves) was recorded in May 1st plantation, increased to 56.7 and 126.8 mines/100 leaves in June 1st and July 1st plantations, respectively. Thus, it is clear that the earliest plantation has the chance to escape the heavy rice leaf miner infestation, while the latest one suffered severe infestation by this insect pest. Similar results were obtained by Sherif *et al*.(2005) who found considerable rice yield losses due to the leaf miner when rice is sown later than May. Differences among the three planting dates and nitrogen levels were highly significant. As for the effect of nitrogen level on rice leaf miner infestation (Table 5), the average of both seasons was highly significantly affected by nitrogen levels. The least percentages of infested leaves were detected with zero and 46 kg N/fed., with values of 28.2 and 29.5 %, respectively. The highest infestation (40.7 %) was obtained with 92 kg N/fed. Similar results were obtained with the number of mines. The least average number (55.8 mines/100 rice leaves) was recorded at zero nitrogen, increased gradually to 64.0, 80.9 and 87.4 mines/100 leaves at 46, 69 and 92 kg N/fed., respectively. It could be concluded that the high nitrogen levels significantly encouraged the infestation by rice leaf miner.

Table 5: Rice leaf miner infestation in Sakha Super 300 rice cultivar as affected by sowing date and nitrogen fertilization level

Treatment	Infested leaves%			Mines / 100 leaves		
Sowing date(S)	2019	2020	Average	2019	2020	Average
May 1st	21.8 c	23.4 c	22.6	29.9 c	35.4 c	32.6
June 1st	30.2 b	35.0 b	32.6	49.6 b	63.8 b	56.7
July 1st	44. 5 a	46.0a	45.2	118.3 a	135.3	126.8
F test	**	**		**	**	
N (kg/fed) (N)						
0	26.8 d	29. 6 c	28.2	51.1 c	60.5 b	55.8
46	29.2c	29.78 c	29.5	57.0 c	71.0 b	64.0
69	32.7 b	37. 5 b	35.8	72.4 b	89.5 a	80.9
92	38. 8 a	42. 6 a	40.7	83.1 a	91.6 a	87.4
F test	**	**		**	**	
Interaction SxN	*	**		**	*	

Data in Table (**6**) show the effect of interaction between rice sowing dates and nitrogen fertilization levels on rice leaf miner infestation. In 2019 season, May 1st plantation had the lowest infestation with all nitrogen levels, ranging between 16.35 and 26.35 % infested leaves. The same trend was recorded in 2020 season, with a range of 22.0-27.33 % infested leaves. However, the levels of infestation increased with delay in sowing, particularly with 69 and 92 kg N/fed. Accordingly, the highest infestation (53.00% infested leaves) was detected in July 1st plantation with 92 kg N/fed. The corresponding value was 56.33% infested leaves for July 1st plantation accompanied with 92 kg N/fed.

Table 6: Effect of interaction between nitrogen levels and sowing dates on percentage of infested rice leaves by rice leaf miner

Sowing date	2019				2020			
	Nitrogen (kg /fed)							
	0	46	69	92	0	46	69	92
infested leaves/100 leaves								
May1st	16.35 h	20.33g	21.33g	26.35f	22.0 g	19.00h	25.35f	27.33ef
June1st	25.33 f	26.67f	31.67e	37.00d	27.35ef	29.67e	39.33d	44.00c
July1st	38.67cd	40.76c	45.35b	53.00a	39.33d	40.67d	47.67b	56.33a

Rice stem borer, *Chilo agammnon* Bles.

Data in Table (7) present the effect of sowing dates and nitrogen fertilization levels on rice stem borer infestation, expressed as dead hearts at the maximum tillering stage, and as whiteheads three weeks prior to harvest. Sowing dates exhibited highly significant differences in both dead hearts and whiteheads, with gradual decreases as the sowing was later. The highest averages were 7.2% dead hearts and 7.9% whiteheads for May 1st plantation. The least averages were 4.6 % dead hearts and 4.8 % whiteheads for July 1st plantation. These results are not in agreement with those reported by Sherif (1980) who obtained higher infestation by the rice stem borer, *Chilo agammnon* in late sown rice compared to the early sown one. This change in the mode of borer infestation may be due to the great shift of planting date of rice in Egypt. Beginning from the 1990s, the early maturing varieties obliged the generations of *C. agammnon* to attack rice plants early in the season, as the third and fourth generations of the borer are flying during September or early October when the rice has already been harvested.

Table 7: Rice stem borer infestation as affected by sowing dates and nitrogen fertilization levels in Sakha Super 300 rice cultivar

Treatment	Dead heart %			Whiteheads %		
Sowing date (S)	2019	2020	Average	2019	2020	Average
May 1st	7.07 a	7.39 a	7.2	7.30 a	8.55 a	7.9
June 1st	6.25 a	6.98 b	6.6	6.05 b	7.18 b	6.6
July 1st	4.25 b	4.85 c	4.6	4.55 c	5.14 c	4.8
F test	**	**		**	**	
N (kg/fed) (N)						
0	3.85 d	4.63 d	4.2	4.37 d	5.15 c	4.8
46	5.24 c	5.86 c	5.6	5.41 c	6.72 b	6.0
69	6.67 b	6.79 b	6.7	6.28 b	8.11 a	7.2
92	7.69 a	8.25 a	8.0	7.75 a	8.37 a	8.1
F test	**	**		**	**	
Interaction SxN	*	*		**	**	

- S x N mean sowing date and nitrogen level.

As for nitrogen levels (Table 7), the dead hearts varied with significant differences with different levels of nitrogen fertilization, while whiteheads varied with highly significant differences. The average dead hearts were recorded as 4.2, 5.6, 6,7 and 8.0 % at zero, 46, 69 and 92 kg N/'fed, respectively. The corresponding values of whiteheads were 4.8, 6.0 7.2 and 8.1 %. Fallah et al. (2019) recommended using 60 kg N/ha. to avoid severe infestation by the rice stem borer, while 90 kg N/ha induced high infestation with the insect. Thus, it could be concluded that both dead hearts and whiteheads decreased gradually as the sowing date was later, but increased as the nitrogen level was higher. Sherif (1996) estimated the annual yield losses in rice as 8 – 10 %. Sultan *et al.*(2014) concluded that high nitrogen fertilization doses encourage the rice leaf miner and rice stem borer infestations as compared to low doses, which is the same trend of the current investigation.

Data in Table (8) show the effect of interaction between sowing dates and nitrogen fertilization levels on rice stem borer infestation. Early sowing with high nitrogen levels enhanced the borer infestation as dead hearts and whiteheads. The highest average of dead hearts (9.4 %) was detected on May 1st plantation fertilized with 92 kg N/fed, while the lowest averages (3.3 and 4.5 %) were recorded for July1st plantation with zero and 46 kg N/fed, respectively. The same trend was found with whiteheads, with the highest average (9.5 %) for May1st plantation fertilized with 92 kg N/fed, while the lowest averages (3.7 and 4.7 %) were recorded for July1st fertilized with zero and 46 kg N/fed, respectively.

Table 8: Effect of interaction between sowing dates and nitrogen fertilization levels on rice stem borer infestation in Sakha Super 300 rice cultivar

Sowing date	Nitrogen kg/ fed.			
	0	46	69	92
% Dead hearts				
May 1st	5.0	6.4	8.0	9.4
June 1st	4.3	5.8	7.3	8.9
July 1st	3.3	4.5	4.8	5.5
% white heats				
May 1st	5.7	6.9	9.6	9.5
June 1st	4.9	5.9	6.9	8.7
July 1st	3.7	4.7	4.9	6.0

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ARABIC SUMMARY

تأثير مواعيد الزراعة ومعدلات السماد النيتروجينى على المحصول والإصابات الحشرية لصنف الأرز سخا سوبر 300

احمد سمير طه [1] ، حسام احمد صالح [2] ، إيمان محمد بليح [1]
1 - قسم بحوث الارز – معهد المحاصيل الحقلية – مركز البحوث الزراعية - مصر.
2- قسم بحوث افات محاصيل الحقل . معهد بحوث وقاية النباتات- مركز البحوث الزراعية مصر.

أجريت تجربة حقليه في المزرعة البحثية لمركز البحوث والتدريب في الأرز - سخا - كفر الشيخ - مصر خلال موسمي (2019 و 2020) بهدف دراسة تأثير ثلاثة مواعيد زراعة وهي (1 مايو ، 1 يونيو ، 1 يوليو) وأربعة معدلات من السماد النيتروجينى (0 ، 46 ، 69 ، 92 كجم / فدان) على المحصول والإصابه بصانعة أنفاق أوراق الارز. ، *Hydrellia prosternalis* Deem. وثاقبة ساق الأرز ، *Chilo agamnnon* Bles. على صنف الأرز سخا سوبر 300.

ومن اهم النتائج المتحصل عليها ان طول النبات ، عدد الايام حتى التزهير ، عدد الحبوب الكلية / سنبلة ، وزن السنبلة ، وزن الألف حبة ومحصول الحبوب كانت أعلى فى الارز المنزرع مبكرا(اول مايو) في كلا الموسمين. و كان اعلى عدد من السنابل / جورة في الارز المنزرع فى الاول من يونيو. كذلك ، كانت نسبة خصوبة الحبوب الأعلى في النباتات المنزرعة اول يونيو، ولكنها كانت الأدنى في النباتات المنزرعة فى الأول من مايو. كما زادت قيم جميع الصفات بزيادة مستوى التسميد النيتروجينى باستثناء الخصوبة ووزن الألف حبة.

كما اشتدت الإصابة بصانعة أوراق الأرز تدريجياً كلما تأخرت الزراعة وكانت أعداد الأوراق المصابة 21.80 و 23.42 / 100 ورقة عند الزراعة في 1 مايو. وكانت أعلى نسبة إصابة 44.45 و 46.00 / 100 ورقة فى الاول من يوليو خلال موسمي 2019 و 2020 على التوالي. كما اخذت النسب المئوية للأنفاق نفس الاتجاه. كما ذادت نسبة الأوراق المصابة والأنفاق بزيادة مستوى التسميد النيتروجينى. وايضا ذادت متوسطات القلوب الميتة الناتجة عن حفار ساق الأرز 7.20 و 6.60 و 4.60 ٪ ، وكانت متوسطات السنابل البيضاء 7.90 و 6.60 و4.80 ٪ في النباتات المنزرعة فى 1 مايو و 1 يونيو و 1 يوليو على التوالي.

أما بالنسبة لمستويات التسميد النيتروجينى فقد اتضح أن الاصابة بحفار ساق الارز زادت تدريجياً (القلوب الميتة والسنابل البيضاء) بزيادة التسميد النيتروجينى. وبالتالي ، يوصى بزراعة الأرز مبكرًا (خلال شهر مايو) بمستويات معتدلة من النيتروجين (69 كجم نتروجين / فدان) لتجنب الإصابة الشديدة بواسطة صانعة أوراق الأرز وحفار ساق الأرز.