

Wheat productivity as affected by rate and addition time of nitrogen fertilizer in sandy land of Luxor governorate

Mohamed N.T. Abd EL-Kader* and Ibrahim S.M. Abdel-Latif

Address:

Wheat Research Department, Field Crops Research Institute, Agricultural Research Center, Egypt.

*Corresponding author: **Mohamed N.T. Abd EL-Kader**, e-mail: noubymohamed912@gmail.com

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ABSTRACT

Wheat cultivar Giza 171 (*Triticum aestivum* L.) was grown on newly reclaimed sandy soil in the area of Al Ghurairah Village, Esna City, Luxor Governorate, Upper Egypt, during the 2018/19 and 2019/20 seasons, to study the effect of adding nitrogen fertilizer rates (240, 285 and 330 kg N ha⁻¹) in different doses (3, 4, 5, 6 and 7 times before heading date) on wheat productivity. Adding the high rate of 330 kg N ha⁻¹ resulted in a significant increase in plant height, spikes number m⁻², grains number spike⁻¹, biological yield, straw yield, and grain yield compared with the low rate of 240 kg N ha⁻¹ in both seasons. The most mentioned traits had no significant difference between 330 and 285 kg N ha⁻¹. The inverse was true in 1000-grain weight, where increasing nitrogen rate reduced it. The nitrogen rate did not affect the weight of spike grains. Splitting nitrogen fertilizer into many doses significantly affected the most studied traits in both seasons. An increasing number of N dose additions from 3 to 7 times gradually increased plant height, spikes number m⁻², grains number spike⁻¹, biological yield, straw yield, and grain yield without significant differences between 6 and 7 times in most cases. The inverse was true in 1000-grain weight, where the increase in N doses reduced it. Splitting N into many doses did not affect the weight of spike grains. The interaction between N rates and dose times significantly affected spikes number m⁻², grains number spike⁻¹, 1000-grain weight, biological yield, straw yield, and grain yield in both seasons. Adding 330 kg N ha⁻¹ in seven doses produced the maximum grain yield (t ha⁻¹) in the two seasons. Adding 330 or 285 kg N ha⁻¹ in 5, 6, and 7 doses did not differ in grain yield.

Keywords: *Wheat*, *Triticum aestivum*, Nitrogen Fertilizer, New Sandy Lands.

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is Egypt's most important food crop and one of the world's most crucial strategic food crops. There is a large gap between the wheat needed for consumption and local production in Egypt. There is a great need to increase wheat production through horizontal and vertical expansion. Growth by horizontal expansion is limited in the old cultivated lands in Egypt, so we must grow wheat in the new lands. The vertical growth of wheat is essential and possible with high-yielding varieties and effective agricultural practices, especially nitrogen fertilizers.

Nitrogen is the primary component of protein, many plant structures, and endogenous and exogenous metabolic processes. It is essential for forming amino acids, the building blocks of plant proteins, and influential in the growth and development of vital plant tissues and cells. There are difficult economic conditions; all the inputs are as expensive as nitrogen fertilizer. Meanwhile, excessive nitrogen use leads to environmental pollution, so we must follow the highest nitrogen use efficiency (NUE) by studying the Effect of nitrogen rates and addition times on wheat Mandic *et al.*, 2015; Kostic *et al.*, 2021. New lands are permeable to irrigation water, so they must be irrigated at short intervals. Nitrogen fertilizer is divided before the expulsion stage into more doses than in the old lands. Nathan., 1963 reported that roots absorb a relatively small proportion of nitrogen during grain growth, although nitrogen uptake continues during grain formation. Between 66 and 75% of the total nitrogen from the growing wheat, the plant is transferred to the seeds and incorporated into storage proteins (McNeal *et al.*, 1972; Koch and Mengel., 1977; and Waldren and Flowerday., 1979).

Many studies reported that increasing nitrogen levels caused a significant increase in the grain yield of wheat, and this increase differed from one to another (Rady and Abo El-Zahab., 1990; Mahdy and Teama., 2000; Ibrahim *et al.*, 2008; Osman *et al.*, 2019 and Ibrahim *et al.*, 2022). Kandile *et al.*, 2016 found that 262 kg N ha⁻¹ produced higher values of spike length, number of grains per spike, and weight of grain, straw, and grain compared

to other levels (214 and 166 kg N ha⁻¹). Morsy *et al.*, 2018 indicated that N-levels significantly affected most yield components, fertilizer use efficiency, and quality of wheat plants in both seasons.

Several researchers also mentioned that increased nitrogen levels were essential in increasing the number of heads/m², number of grains/spike, 1000-grain weight, and grain weight/spike (Sultan and Bazzaz., 1993; Seleem and El-Dayem., 2013; Zhang *et al.*, 2017; Saad *et al.*, 2022).

This study aimed to determine the best nitrogen fertilization rate and dose times to achieve maximum wheat productivity and increase NUE in the newly reclaimed sandy soil under the surface irrigation system.

MATERIALS AND METHODS

Wheat cultivar Giza171 (*Triticum aestivum* L.) was grown on newly reclaimed sandy soil in the area of Al Ghurairah Village, Esna City, Luxor Governorate, Upper Egypt, during the 2018/19 and 2019/20 seasons, to study the effect of adding nitrogen fertilizer rates in different doses on wheat productivity. The experiment was carried out in the same experimental site during the two planting seasons, Soil samples were taken at a depth of 0-30 cm to determine physical and chemical properties, as shown in Table 1.

Table 1. Physical and Chemical analysis of the experimental soil at 0-30 cm depth.

Particle size (%)			Texture grade	Soluble cations (meq l ⁻¹)				Soluble anions (meq l ⁻¹)				OM (%)	EC (ds/m)	pH (1:2.5)	Total Soluble N (ppm)
Sand	Silt	Clay		Na+	K+	Ca ⁺⁺	Mg ⁺⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	CO ₃ ⁻				
85.5	9.4	5.1	Sandy	1.71	0.4	0.75	0.4	0.74	1.75	0.77	0	0.12	0.33	8.1	11.2

During soil preparation, the experimental field was fertilized with 71.4 kg P₂O₅ ha⁻¹ as calcium superphosphate (15.5 % P₂O₅) and 119 kg K₂O ha⁻¹ as potassium sulphate (48 % K₂O).

The experiment involved adding three nitrogen fertilizer rates (240, 285, and 330 kg N ha⁻¹) as ammonium nitrate (33.5 % N) in 3, 4, 5, 6, and 7 equal doses before the heading stage of wheat, as shown in Table 2. The experiment was laid out in a strip plot design with three replications. The horizontal plots were assigned to nitrogen rates, and the vertical plots to dose times. The plot size was 10.5 m² (3 X 3.5 m). Each plot was isolated by a distance of 1.5 m wide to avoid horizontal leakage of fertilizers between plots under the surface irrigation system. Wheat seed was drilled by hand in rows 20 cm apart at the rate of 178.6 kg seed ha⁻¹ on 23 and 25 November in the 2018 and 2019 seasons, respectively. Each plot included 15 rows.

Table 2. Dates of adding nitrogen doses

Days after sowing	Dose times				
	3	4	5	6	7
6	1	1	1	1	1
24	1	1	1	1	1
36	-	-	-	1	1
42	-	-	1	1	1
60	1	1	1	1	1
72	-	1	1	1	1
78	-	-	-	-	1

Surface irrigation was done for the experimental soil approximately every six days during the growing season. All other agricultural operations followed the standard wheat-growing recommendations in the new lands.

At harvest, the traits recorded were plant height, number of spikes m⁻², number of grains spike⁻¹, 1000-grain weight, grains weight spike⁻¹, biological yield, grain yield, and straw yield.

The obtained data were subjected to analysis of variance according to Gomez and Gomez (1984). Treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

I. Plant height:

A. Effect of nitrogen rate:

Data in Table 3 show that nitrogen fertilizer rates significantly affected plant height in both seasons. Adding the high rate of 330 kg N ha⁻¹ resulted in a significant increase in plant height compared with the low rate of 240 kg N ha⁻¹ in both seasons. The medium rate of 285 kg N ha⁻¹ did not significantly differ from the two mentioned N rates in plant height in the two seasons.

B. Effect of N doses number:

Splitting nitrogen fertilizer into many doses gradually increased the plant height in the two seasons (Table 3). Adding N fertilizer into 5, 6, and 7 doses markedly increased plant height compared with adding N in 3 doses in both seasons. The tallest plants were obtained by adding N in 7 doses, while the shortest ones were obtained by adding N in 3 doses in both seasons. No significant differences in plant height between 6 and 7 doses were found in the two seasons.

C. Effect of interaction:

The interaction between nitrogen rate and dose number did not significantly affect plant height in the two seasons.

II. Yield attributes:

Spikes number m⁻², grains number spike⁻¹, 1000-grain weight, and weight of spike grains as affected by nitrogen rate and dose number in 2018/19 and 2019/20 seasons are present in Tables 3 and 4.

A. Effect of nitrogen rate:

There were substantial differences in spikes number m⁻², grains number spike⁻¹, and 1000-grain weight obtained among nitrogen rates in both seasons. The increasing rate from 240 to 330 kg N ha⁻¹ significantly increased spikes number m⁻² and grains number spike⁻¹ in both seasons. The 285 and 330 kg N ha⁻¹ were statistically at par in spikes number m⁻² and grains number spike⁻¹ in the two seasons. Adding 285 and 330 kg N ha⁻¹, being insignificant, resulted in a significant reduction in 1000-grain weight compared with 240 kg N ha⁻¹ in the two seasons. Data in Table 4 show that the N rate did not significantly affect the spike grain weight in both seasons.

Table 3. Plant height and some yield attributes of wheat as affected by nitrogen fertilizer rate, dose time and their interaction in 2018/19 and 2019/20 seasons.

Factor	Plant height (cm)		Spiks (No m ⁻²)		Grains (No spik ⁻¹)		1000-grain weight (g)	
	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Kg N/ha (N)								
240	105 b	110 b	404 b	414 c	64 b	66 b	54.57 a	54.31 a
285	112 ab	113 ab	421 a	422 b	68 a	67 ab	52.64 b	52.65 b
330	115 a	117 a	432 a	430 a	71 a	70 a	52.49 b	51.99 b
F test	*	*	*	*	*	*	*	*
Dose time (T):								
3	106 d	108 d	372 d	396 d	61 c	63 c	53.57 a	53.27 a
4	108 cd	111 cd	399 c	408 cd	64 c	66 bc	53.40 a	53.22 a
5	111 bc	114 bc	429 b	417 c	68 b	68 b	53.39 a	52.97 ab
6	113 ab	116 ab	444 a	434 b	69 b	68 b	53.33 a	52.84 ab
7	116 a	118 a	451 a	455 a	76 a	74 a	52.47 b	52.63 b
F test	*	*	*	*	*	*	*	*
Interaction (NxT)	NS	NS	*	*	*	*	*	*

* and NS indicate $p < 0.05$ and not significant, respectively. Using Duncan's Multiple Range Test, the means of each factor followed by the same letter are not significantly different at 5% level.

B. Effect of N doses number:

Several nitrogen addition doses markedly influenced spikes number m⁻², grains number spike⁻¹, and 1000-grain weight in the two seasons. Increasing N doses from 3 to 7 times gradually increased spikes number m⁻² and grains number spike⁻¹ in both seasons. The greatest spike numbers m⁻² and grain number spike⁻¹ were obtained by adding N in seven doses, and the lowest was obtained by adding N in three doses. On the contrary, increasing the number of nitrogen addition into seven doses decreased the 1000-grain weight compared with the other doses. The seven N doses produced a lighter 1000-grain weight than the 3, 4, 5, and 6 doses, which did not differ significantly. Nitrogen addition doses had no significant effect on the weight of spike grains in the two seasons (Table 4).

Table 4. Grain, straw and biological yields and spike grains weight of wheat as affected by nitrogen fertilizer rate, dose time and their interaction in 2018/19 and 2019/20 seasons.

Factor	Grains weight (g spike ⁻¹)		Biological yield (t ha ⁻¹)		Straw yield (t ha ⁻¹)		Grain yield (t ha ⁻¹)	
	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Kg N/ha (N)								
240	3.79 a	3.81 a	14.89 b	16.09 b	9.67 b	10.27 b	5.23 b	5.82 b
285	3.66 a	4.01 a	16.79 a	18.20 a	10.89 a	11.7 a	5.87 a	6.48 a
330	3.80 a	3.77 a	17.38 a	18.39 a	11.24 a	11.7 a	6.19 a	6.72 a
F test	NS	NS	*	*	*	*	*	*
Dose time (T):								
3	3.66 a	3.80 a	14.37 b	15.90 c	9.52 b	10.16 b	4.95 c	5.75 c
4	3.62 a	3.92 a	15.88 ab	17.05 bc	10.37 ab	11.10 ab	5.50 b	6.05 bc
5	3.70 a	4.05 a	16.61 a	17.94 ab	10.58 ab	11.50 a	5.89 ab	6.44 ab
6	3.97 a	3.82 a	17.73 a	18.12 ab	11.46 a	11.52a	6.21 a	6.63 ab
7	3.80 a	3.72 a	17.15 a	18.76 a	11.05 a	11.85a	6.27 a	6.84 a
F test	NS	NS	*	*	*	*	*	*
Interaction (NxT)	NS	NS	NS	NS	NS	NS	*	*

* and NS indicate $p < 0.05$ and not significant, respectively. Using Duncan's Multiple Range Test, the means of each factor followed by the same letter are not significantly different at 5% level.

C. Effect of interaction:

The interaction between nitrogen rate and dose number significantly affected spikes number m^{-2} , grains number spike⁻¹, and 1000-grain weight in the two seasons Table (3). Figure 1 illustrates that spikes number m^{-2} was increased by increasing the N rate and N dose times. At the same N rate, spikes number m^{-2} were substantially increased by increasing N doses from 3 to 7 times. The differences in spikes number m^{-2} were slight among the three N rates at 6 and 7 doses. The greatest spikes number m^{-2} were obtained from adding 330 kg N ha⁻¹ in 7 doses, while the lowest values were obtained from adding 240 kg N ha⁻¹ in 3 doses in the two seasons.

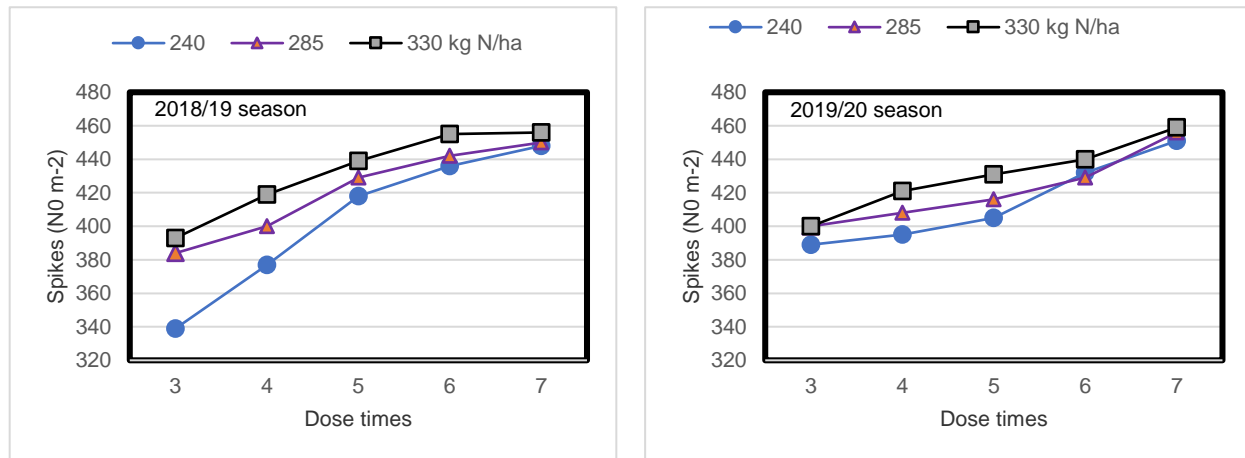


Fig. (1): Number of spikes m^{-2} as affected by the interaction between nitrogen fertilizer rate and dose times in 2018/19 and 2019/20 seasons.

Figure 2 illustrates that grain number spike⁻¹ was gradually increased at each N rate by increasing additional doses. At the same dose, increasing the N rate increased grain number spike⁻¹. Adding 330 kg N ha⁻¹ into any dose was superior to adding 240 kg N ha⁻¹ in grain number spike⁻¹ in both seasons. There were no significant differences in grain number spike⁻¹ between 285 and 330 kg N ha⁻¹ at most doses, especially in the second season. The highest grain number spike⁻¹ was obtained from adding 330 kg N ha⁻¹ in 7 doses, while the lowest values were obtained from adding 240 kg N ha⁻¹ in 3 doses in the two seasons.

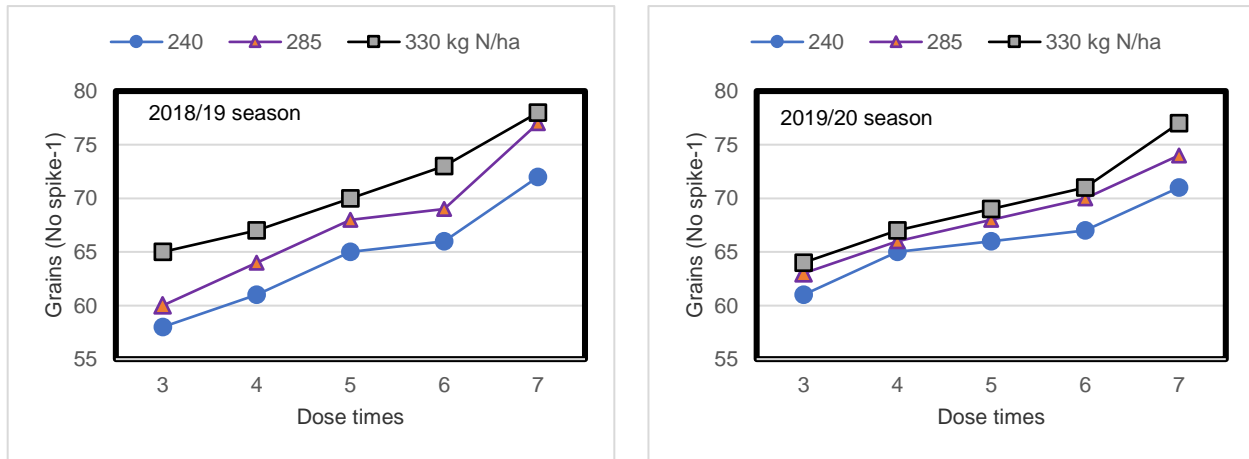


Fig. (2): Number of grains spike⁻¹ as affected by the interaction between nitrogen fertilizer rate and dose times in 2018/19 and 2019/20 seasons.

Figure 3 illustrates that increasing the additional doses of 240 kg N ha⁻¹ from 3 to 7 times resulted in a substantial increase in 1000-grain weight in both seasons. On the contrary, the 1000-grain weight was sharply declined by increasing the additional doses of 285 and 330 kg N ha⁻¹ from 3 to 7 times. The differences in 1000-grain weight were slight between 285 and 330 kg N ha⁻¹ at most doses times. The heaviest 1000-grain weight was obtained from adding 240 kg N ha⁻¹ in 7 doses, while the lowest values were obtained from adding 330 kg N ha⁻¹ in 7 doses in the two seasons.

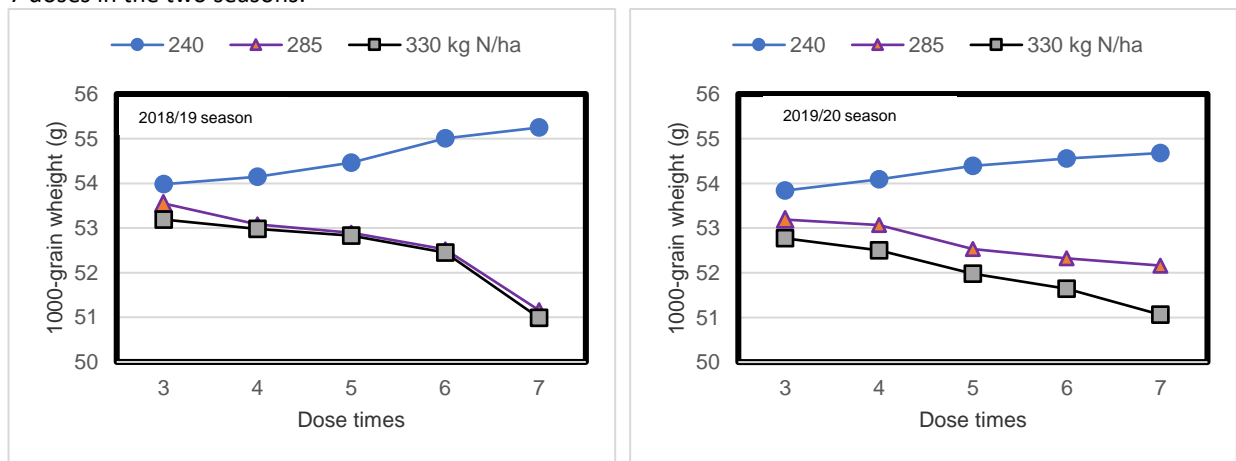


Fig. (3): 1000-grain weight as affected by the interaction between nitrogen fertilizer rate and dose times in 2018/19 and 2019/20 seasons.

The interaction between nitrogen rate and dose number did not significantly affect the weight of spike grains in the two seasons Table (4).

II. Biological, straw, and grain Yields:

Biological, straw, and grain yields as affected by nitrogen rate and dose number in the 2018/19 and 2019/20 seasons are presented in Table 4.

A. Effect of nitrogen rate:

There was a substantial difference in biological, straw, and grain yields obtained among nitrogen rates in both seasons. Increasing the nitrogen rate from 240 to 330 kg N ha⁻¹ significantly increased biological, straw, and grain yields. The 285 and 330 kg N ha⁻¹ were statistically at par in biological, straw, and grain yields in the two seasons.

B. Effect of N doses number:

Several nitrogen addition doses markedly influenced biological, straw, and grain yields Table (2). Adding nitrogen in 5, 6, and 7 doses, being insignificant, resulted in a significant increase in biological, straw, and grain yields compared with three doses in both seasons. The highest values of biological, straw and grain yields were obtained from adding N in 7 doses, while the lowest values were obtained from adding N in 3 doses.

C. Effect of interaction:

The interaction between nitrogen rate and dose number did not significantly affect biological and straw yields in both seasons Table (4). However, the interaction between nitrogen rate and dose number significantly affected grain yield in the two seasons. Figure 4 shows that increasing N rates and doses increased grain yield per hectare. Adding 330 kg N ha⁻¹ outyielded 240 kg N ha⁻¹ in grain yield at any dose time in both seasons. The differences in grain yield were slight between 285 and 330 kg N ha⁻¹ at most doses, especially at 6 and 7 doses in the two seasons. The maximum grain yield was obtained from adding 330 kg N ha⁻¹ in 7 doses, while the lowest was from adding 240 kg N ha⁻¹ in 3 doses in the two seasons.

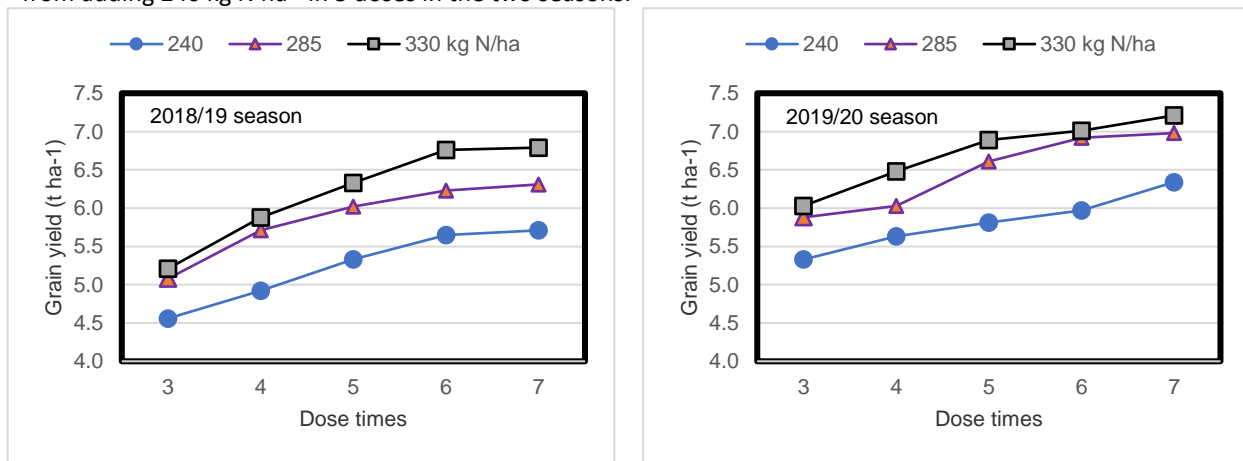


Fig. (4): Grain yield as affected by the interaction between nitrogen fertilizer rate and dose times in 2018/19 and 2019/20 seasons.

DISCUSSION

The results show that adding nitrogen fertilizer at different rates in several doses in the newly reclaimed sandy land increased nitrogen fertilizer efficiency use and nitrogen availability for plant uptake during the growing season under surface irrigation.

Plant height was increased by increasing the N rate from 240 to 330 kg N ha⁻¹ and adding doses from 3 to 7 times. The increase in plant height may be attributed to an adequate supply of nitrogen, which can be explained by more cell division and elongation of internodes, increasing plant height. These results agree with those obtained by El-Samahy., (2009); Osman., *et al.* (2019) and Ibrahim., *et al.*, (2022).

Adding 285 to 330 kg N ha⁻¹, being insignificant, resulted in a substantial increase in spikes number m⁻² and grains number spike⁻¹ compared with 240 kg N ha⁻¹ in both seasons. Certainly, increasing N rates up to an adequate level might be due to its role in induced vegetative growth and the expansion of leaves, which resulted in great photosynthetic available for dry matter accumulation and the number of tillers, in turn, increased spike number and grain number per spike. The promoting effects of nitrogen on spikes number m⁻² and grains number spike⁻¹ were reported by (El-Samahy., 2009, Osman., *et al.*, 2019, Badawy., *et al.*, 2021 and Ibrahim., *et al.*, 2022). The 1000-grain weight was substantially decreased by increasing the N rate without a significant difference between the medium and high rates in the two seasons. The reduction in 1000-grain weight at a high N rate may be due to increasing nitrogen content in the plant, which may result in a shortage of carbohydrates supplied per grain. In turn, it is directly caused by excessive grains produced by high N fertilization. These findings are consistent with those of El-Samahy., 2009 and Badawy., *et al.* (2021). The nitrogen rate did not affect the weight of spike grains because increasing the N rate increased the number of grains spike⁻¹ and decreased the grain weight and vice versa. This result reflected the negative correlation between the number of grains spike⁻¹ and grain weight (1000-grain weight).

Increasing the nitrogen rate from 240 to 330 kg N ha⁻¹ significantly increased biological, straw, and grain yields with no significant differences between 285 and 330 kg N ha⁻¹. The increase in straw yield at 285 and 330 kg N ha⁻¹ could be attributed to an increase in tillers per unit area and plant height. Thus, adding 285 and 330 kg N ha⁻¹ increased grain yield by increasing the number of spikes m⁻² and grains spike⁻¹. The increase in biological yield has reflected grain and straw yield increases. These results are in agreement with those obtained by Iqtidar *et al.*, (2006), Subedi *et al.*, 2007; Zafar and Muhammad., 2007; Gorjanovic and Kraljevic-Balalic., 2008; Marino *et al.*, 2009; Abedi *et al.*, 2011; Haile *et al.*, 2012; Gheith *et al.*, 2013; Noureldin *et al.*, 2013; Seleem and Abd El-Dayem., 2013; Yousaf *et al.*, 2014; Todeschini *et al.*, 2016 and Badawy *et al.* (2021). Assenge *et al.*, 2001 and Liu *et al.*, 2019 reported that the yield response to an increased rate of nitrogen fertilizers was high in sandy soils.

The results confirmed the need to fragment nitrogen fertilizer in newly reclaimed sandy lands to increase N efficiency use and availability for plant uptake during the growing season under surface irrigation. Splitting nitrogen fertilizer into many equal doses (3, 4, 5, 6 and 7 times) significantly affected all studied characters except the weight of spike grains in both seasons. An increasing number of N dose additions from 3 to 7 times gradually increased plant height, spikes number m⁻², grains number spike⁻¹, biological yield, straw yield, and grain yield without significant differences between 6 and 7 times in most cases. The inverse was true in 1000-grain weight. Splitting nitrogen fertilizer into seven doses resulted in a substantial increase in the number of grains per spike and a reduction in 1000-grain weight; thus, this inverse effect resulted in no significant difference among N doses time for the weight of grains per spike. Splitting nitrogen fertilizer increased nitrogen availability for the plant for a long time, leading to an increase in vegetative growth, plant height, tillers, spikes, and grains per spike, ultimately increasing wheat productivity in sandy soil. These results agree with Barbieri *et al.*, 2008 and Jan *et al.*, (2011) concluded that the split application of NH₄-N performed better than complete dose application and/or NO₃-N for improved wheat productivity. Singh and Bhan (1998) found that the split application might have fulfilled the plant N requirement due to the greater availability of N for a prolonged time. Belete *et al.* (2018) found that applying 240 kg N ha⁻¹ in three divided doses required optimum wheat yield.

The interaction between nitrogen rate and dose time significantly affected grain yield per hectare and its attributes (spikes number m⁻², grains number spike⁻¹, and 1000-grain weight) in the two seasons. Except for the 1000-grain weight, the combination of 285 or 330 kg N ha⁻¹ and 6 or 7 doses, being insignificant, produced a maximum of spikes number m⁻² and grains number spike⁻¹, ultimately, maximum grain yield. The inverse was true in 1000-grain weight. It can be concluded that the addition of 285 kg N ha⁻¹ in 6 or 7 doses before the heading stage of wheat was the best treatment, which resulted in high grain yield without significant difference than 330 kg N ha⁻¹ in 7 doses

Conclusion

Adding 285 kg N ha⁻¹ in six or seven equal doses was the recommended treatment for optimum grain yield in newly reclaimed sandy soil in the area of Al Ghurairah Village, Esna City, Luxor Governorate and Upper Egypt.

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تأثير إنتاجية القمح بمعدل وزمن إضافة الأسمدة النيتروجينية في الأراضي الرملية بمحافظة الأقصر

محمد نوبى طه عبد القادر* و ابراهيم صبرى محمد عبداللطيف

قسم بحوث القمح، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية، الجيزة، مصر

* بريد المؤلف المراسل noubymohamed912@gmail.com

تم زراعة صنف القمح جيژه 171 في تربة رملية حديثة الاستصلاح في منطقة قرية الغريرة - مركز إسنا - محافظة الأقصر - صعيد مصر، خلال موسمي 19/2018 و 20/2019، لدراسة تأثير إضافة ثلاث معدلات من السماد النيتروجيني (240 و 285 و 330 كجم نيتروجين للهكتار) على دفعات مختلفة (3 و 4 و 5 و 6 و 7 دفعات متساوية قبل مرحلة طرد السنابل) على إنتاجية القمح، لتحديد أفضل معدل سماد نيتروجيني مع أفضل عدد من دفعات الإضافة. أدت إضافة المعدل المرتفع 330 كجم ن/هكتار إلى زيادة معنوية في ارتفاع النبات وعدد السنابل/م² وعدد الحبوب/سنبله والمحصول البيولوجي ومحصول القش، ومحصول الحبوب بالهكتار مقارنة بالمعدل المنخفض 240 كجم ن/هكتار في كلا الموسمين. ولم يختلف معدل 285 عن 330 كجم ن/هكتار في الصفات السابق ذكرها. وقد أدت زيادة معدل السماد النيتروجيني إلى انخفاض وزن حبة. ولم يتأثر وزن حبوب السنبله معنويًا بعدد دفعات إضافة النيتروجين بسبب العلاقة العكسية بين عدد الحبوب/سنبله ووزن 1000 حبة. أثر التفاعل بين معدلات النيتروجين وعدد دفعات الإضافة معنويًا على عدد السنابل/م² وعدد الحبوب/سنبله ووزن 1000 حبة والمحصول البيولوجي ومحصول القش، ومحصول الحبوب بالهكتار في الموسمين. أدت إضافة 330 كجم ن/هكتار على سبع دفعات إلى الحصول على أقصى محصول حبوب/هكتار في الموسمين. ولم يختلف محصول الحبوب معنويًا عند إضافة 330 أو 285 كجم ن/هكتار على 5، 6، 7 دفعات في الموسمين. ويستنتج من نتائج هذه الدراسة أنه يمكن إضافة 285 كجم ن/هكتار على 6 أو 7 دفعات للحصول على محصول حبوب من الأرض الرملية حديثة الإستصلاح بمركز إسنا - محافظة الأقصر.

الكلمات المفتاحية: القمح، قمح الخبز، التسميد النيتروجيني، الاراضي الرملية الجديدة