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RESPONSE OF THREE WHEAT VARIETIES TO NITROGEN LEVELS, SEEDING RATES AND THEIR COMBINATION; 2: SPIKE CHARACTERS

KEY WORDS: Wheat, verities, spike characters, N levels and seeding rates.

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ABSTRACT

To achieve larger production per unit area, sciences and farmers face a great defiance in improving cropping practices and elicitation new top yielding wheat varieties and also to establish the effects of these factors on the spike characters. Two years experiment were conducted to evaluate the effect of three nitrogen fertilizer levels (recommend rate 80 kg N/fed and 25% lower and higher than the recommended, i.e. 60 and 100 kg N/ fed, three seeding rates (40, 60 and 80 kg grains/fed) and there varieties (Giza-171, Gemmiza-12 and Shandawil-1), on spike characters of wheat at the Agricultural and experimental Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt during 2018/2019 and 2019/2020 seasons. The experimental design was a split- split plot in randomized complete block arrangement with three replications. Nitrogen levels were allocated to the main plots, while the sub plots were assigned for seeding rates. Wheat varieties were distributed at random in the sub-sub plots. Each sub-sub plots area 4 m^2 (2 x 2m). Generally, results indicated that significant effect on spike length and number of grains/ spike in both seasons and on weight of grains/ spike and 1000-grain weight in one season, where the tallest and heaviest spike as well as the heaviest 1000-grain weight were produced at the 100 kg N/fed in both seasons but the highest number of grains/spike was obtained at 80 kg N/fed in one season. It could be concluded that application nitrogen at the rate of 100 kg/fed proceed the favorable effect on spike characters under the environmental conditions of the experimental site and the similar conditions. Seeding rates caused a significant effect on all studied traits in one season, so the highest values were at 80 kg grains/fed, but this effect on 1000-grain weight was true in both seasons, where the highest value was at 60 kg grains/fed. Moreover, varieties were significantly differed in all spike character in both seasons except number and weight of grains/spike in one season where Giza-12 variety surpassed others. Al studied interactions had significant effect on all studied traits either in one or two season. Planting Giza-171 with 80 kg grains/fed and application of 100 kg N/fed was the pest treatment.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop in the world and is a staple food of about one third of the world's population including Egypt. In Egypt, wheat is the most important cereal crop both in terms of production and area under cultivation. Wheat was cultivated on an area of 3.4 million feddan (one feddan = 4200m^2) yielded about 9.3 million ton (FAOSTAT, 2018). Egypt imports more than 50% of its wheat requirement. Therefore, increasing wheat production is on important good to reduce the gap between production and consumption through expanding the wheat cultivated one and increasing productivity per unit area. Consequently, increasing wheat production under Egyptian conditions is major concern of Agronomist (Rizkalla *et al.*, 2012 and Gheith *et al.*, 2018). Moreover, yield of is function of many factors among which seeding rates, nitrogen fertilization and varieties … etc being the most important one. Nitrogen fertilizer is one of the most important factors for crop growth, high yield, yield components and grain quality, where a nitrogen element plays an essential role in many compounds essential. Nitrogen is of vital importance for plant growth due to being a part of amino acid, protein, enzymes and chlorophyll molecule. It is considered the key element in increasing crop productivity, also, helps the use of P, K and other elements. Several investigations formed positive response of wheat to nitrogen fertilization (Duan *et al.*, 2012; Haile *et al.*, 2013; Wahid, 2013; Chen *et al.*, 2019; Ghaith *et al.*, 2019 and Yang *et al.*, 2019). The yield of wheat is the result of inter-plant-plant and intra plant completion in the growth environments. Maximum yield is archived when the competition reaches its minimum and the plant can minimize the usage of the environmental factors. See table density and balanced distribution of plants per unit area which resulted from seeding rates in better use of moisture, nutrients, light and increased yield. In general, determination of the best plant density (seeding rates) is one of the important requirements in agronomic planning for achieving high yield with optional quality. In order to mitigate the deleterious effect of seeding rates, several researchers (Nauman *et al.*, 2011; Gheith *et al.*, 2013; Shemi, 2016; Protic *et al.*, 2019 and Gheith and Ola El-Badry, 2020) suggested to positive effect of seeding rates on wheat yield and its components. Therefore, the wheat varieties Giza-171, Gemmiza-12 and Shandawill-1 are the new and important varieties of high quality bread in Egypt, with little research about seeding rates and nitrogen fertilizer. There it will make difference to do research about reasonable nitrogen level on these varieties to improve wheat yield and quality. So, keeping of view the above mentioned facts, the present study was conducted to find out the proper nitrogen fertilizer levels, the precise seeding rate and varieties on growth, yield and quality of wheat.

MATERIALS AND METHODS

Two years field experiment were conducted to evaluate the effect of different nitrogen fertilizer levels, seeding rates and varieties on spike characters of wheat at the Agricultural and Experimental Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt during 2018/2019 and 2019/2020 seasons. Representative soil samples were taken from each site at the depth of 0-30 cm from the soil surface. The soil analysis of the experimental soil, as the two growing seasons 2018/2019 and 2019/2020, indicated that the soil is clay loam (3.6 % coarse sand, 30.9 % fine sand, 31.4 % silt and 34.1% clay), the organic matter is 1.6 and 1.9%, the pH (paste extract) is 7.6 and 7.7, the EC is 2.3 and 2.4 dSm^{-1}, the available nutrients Nitrogen (46.5 and 49.8 *ppm*), Phosphorous (13.7 and 13.5 *ppm*) and Potassium (336.0 and 367.0 *ppm*) in both seasons, respectively. The procedure of soil analysis followed the methods of Black (1965). The experimental design was a split- split plot in randomized complete block arrangement with three replications. Nitrogen levels were allocated to the main plots, while the sub plots were assigned for seeding rates. Wheat varieties were distributed at random in the sub-sub plots. Each sub-sub plots area 4 m^2 (2 x 2m).

The treatments comprises three different nitrogen fertilizer levels, i.e 60 kg N/fed (25% lower than the recommended rate), 80 kg N/fed (recommended rate) and 100 kg N/fed (25% higher than the recommended rate), three different seeding rates, i.e 40, 60 and 80 kg grains/fed (one feddan = 4200 m^2) and different wheat varieties, i.e, Giza-171, Gemmiza-12 and Shanawil-1. Grains of these varieties were obtained from Wheat Research Section, Field Crops Research Institute, Agricultural Research Center (ARC), Giza, Egypt. Wheat grains were handily drilled in rows spaced 20 cm apart on 22^{th} and 18^{th} November in both seasons, respectively. The preceding crop was corn in both seasons. Nitrogen in the form of area (46.5% N) was split into two portions. Half of nitrogen was applied at sowing, while remaining half of nitrogen was applied at the first irrigation. All other agronomic practices were kept normal and uniform.

Studied characteristics:

at harvest data about spike characters i.e. spike length (cm), calculated by taking the average length of 10 spikes, number of grains/spike, computed as an average number of grains from a random sample obtained from 10 spikes randomly from each plot, weight of grains/spike, calculated as an average weight of grains of 10 spikes and 1000-grain weight.

Statistical Analysis:

All the data collected during the both seasons were subjected to statistical analysis using Excel data sheet by using statistical software package MSTAT-C (Michigan State University, 1990). Least Significant Differences test (L.S.D) at 0.05% probability was employed to test the significant differences among mean values of each treatment (Steel *et al.*, 1997).

RESULTS AND DISSCTIONS

Spike length

The results showed that the effects of nitrogen (Table 1), seeding rates (Table 2) in the second season and varieties (Table 3) were significant on spike length in both seasons. According to the results of the mean comparison, the highest spike length (13.7.6 and 12.3. cm) was observed in the first and the second season in the supplication of nitrogen fertilizer at 100 kg N/fed, respectively and the lowest mean (13.5 and 12.1 cm) was achieved in nitrogen rate 60 kg N/fed/g N/fed in both season, respectively. This increase in spike length could attributed to role of nitrogen as an essential element in building wheat spikes due to the effect on photosynthetic activity in plant and its positive effects on wheat growth. There inferences are in line with the earlier researchers on wheat undertaken by (Gheith *et al.*, 2013; Sandhya *et al.*, 2014; Keshavarz *et al.*, 2015; Mansour, 2017; Mosanaei *et al.*, 2017; Gheith *et al.*, 20118; Yang *et al.*, 2019 and Gheith and Ola El-Badrey, 2020) who recorded that spike length of wheat was significantly affected with applications of nitrogen fertilizer. Seeding rates had a significant effect on spike length in the second season where the tallest spikes (12.3 cm) were obtained at each of 60 and 80 kg grains/fed. These results are in harmony with those obtained by Chen *et al.* (2019) and Gheith and Ola El-Badry (2020). Sandawil-1 significantly supported other varieties and produced tallest spikes (13.7 and 12.3 cm) in both seasons, respectively. Protic *et al.* (2019) and Gheith and El-Badry (2020) recorded similar results. Moreover, all studied interactions, except seeding rates x varieties, in the second season, had significant effect on spike length in both seasons. The tallest spikes were recorded under Giza-171 variety + 60 kg grains/fed + 100 kg N/fed (result not presented). The present results are in harmony with those obtained by Shemi (2016) who found that N levels x seeding rates x varieties interaction had a significant effect on spike length.

Number of grains/ spike

As well filled spike with a greater number of grains has a huge correlation with grain yield. Results showed that the effect of nitrogen fertilizer levels was significant on grain number per spike in both seasons (Table 1). The highest number of grains/spike (70.1 and 62.2) was achieved in the application of nitrogen fertilizer passed on 80 and 60 kg N/fed in both seasons, respectively and the lowest mean (63.0 and 55.7) was in the nitrogen application rate of 60 and 80 kg N/fed in both seasons, respectively. This finding might be due to the well utilization of nitrogen fertilizer in metabolism and meristemtic activity which improved growth character and yield component such as this trait. Moreover, marked increase in number of grains/spike contributed for the significant increase, in spike length. The present result was supported by Nauman *et al.* (2011), Gheith *et al.* (2013), Kousar *et al.* (2015), Shemi (2016), Wang *et al.* (2016), Yang *et al.* (2019) and Gheith and Ola El-Badry (2020) who concluded that nitrogen applications significantly affected number of grains/ spike. Among ding rates, results indicated that means of grains number/spike were varied significantly comparing between the tested seeding rates with each other in the first growing season. Except for the higher seeding rate (80 kg/fed) that was the highest mean (69.8 grain); other treatments had the lowest average number of grains/spike (Table ٢). These results show similarity with result of Nauman *et al.* (2011), Haile *et al.* (2013), Wang *et al.* (2016) and Protic *et al.* (2019) and Gheith and Ola El-Badry (2020) who found that number of grains/spike increased with successive increase in seeding rates. On the contrary, Shemi (2016) reported that seeding rates not affecting this trait significantly. Concerning, the tested varieties the highest number of grains/spike (70.1) was produced by Gemmiza-12 variety and the lowest value (63.0) was formed by Giza-171 variety in the first season (Table ٣). On the other hand and in the second season, the highest number of grains/spike (62.3) was obtained under Giza-171 and the lowest value (55.7) was recorded under Gemmiza-12 (Table ٣). This observation indicated that significant variation among the varieties might be partially reflecting their different genetic background. These results are in line with those obtained by Abou-Taleb and Gomma (2012), Gheith *et al.* (2013) and Haile *et al.* (2013) and Shemi (2016). The most of studied interactions had significant effect on this trait where the highest number of grains/spike resulted from either Sandawil-1 or Giza-171 which planted with 60 kg grains/fed and application of 100 kg N/fed in both seasons, respectively (result not presented).

Grains Weight/Spike

The application of nitrogen fertilizer significantly affected grains weight/spike in the first season, where the heaviest spikes (4.5 g) was produced at 100 kg N/fed and the lowest weight (4.2 g) was recorded at 60 kg N/fed (Table 1). This increment may be due to the increase in spike length, number of grains/spike. Similar results were also obtained by Wahid (2013), Rasool *et al.* (2014), Shemi (2016), Mansour (2017) and Chen *et al.* (2019) who showed that increasing nitrogen levels significantly increased this trait. As regarding to seeding rate, grain weight/spike increased significantly and gradually with increasing seeding rates in the second season, where the heaviest spikes (3.4 g) was observed at 80 kg grains/fed and the lowest weight/spike (2.2 g) was obtained at 40 kg grains/fed (Table ٢). Among the tested varieties, the significant differences were found in second season (Table 3). Shandawil-1 variety gave the heaviest spikes (3.6 g). These results are good in harmony with these obtained by Gheith *et al.* (2013), Wahid (2013) and Chen *et al.* (2019) and Protic *et al.* (2019). All studied interactions in the first season and N levels x varieties in the second season had significant effect on this trait and the best treatment was Giza 171 variety + 60/kg grains/fed + 100/g N/fed (results not presented).

1000-grain weight

The weight of 1000-grains is one of the important qualitative criteria of grain, which is a function of seeding rate and grain filling period. From the results in Table (1), it was clear that there was significant difference, in 1000-grain weight between N level in the both seasons where the highest value of 1000 grain weight (57.2 and 66.7g) was recorded at 100 kg N/fed and the lowest value (55.0 and 64.8 g) was achieved at 60 kg N/fed in the both seasons, respectively.

These results are due to the encouraging effect of nitrogen on growth characters and yield components such as 1000-grain weight. Keshavarz *et al.* (2015) found that greater 1000-grain weight in fertilized plots can be attributed to the availability of nitrogen at grain formation stage. These findings were in conformity with application of nitrogen significantly affected spike length and number of grain/spike in both seasons as well as grain weight/spike and 1000-grain weight in one season. Based on the results presented in Table (٢), the effect of seeding rates on 1000-grain weigh was significant in both seasons.

Seeding rate of 80 kg grains/fed produced the highest value (56.7 and 66.3g), however seeding rate of 40 kg produced significantly lower 1000-grain weight (56.4 and 65.2g) in both seasons, respectively. Increase in 1000-grain weight at the highest seeding rate might be due to more nutrients availability as compared to lower seeding rate. These results are in consequence with that of Nauman *et al.* (2011), Shemi (2016) and Mosanaei *et al*. (2017) who reported that increasing seeding rates caused on increase in this trait. Regarding varieties, significant results were obtained in both seasons. The highest values (57.3 and 66.8 g) were belonged to Giza-171 variety, while the lowest values (55.0 and 64.8 g) were recorded at Shandweil-1 variety in both seasons, respectively (Table 3).

These results may be due to the differences among these varieties that could be attributed to their genetic constitutions as well as their response to the prevailing environmental conditions. All studied interactions have significant effect on 1000-grain weight in the first season, where the optimum treatment was the combination of shandweil-1 variety + 60 kg grains/fed + 100 kg N/fed (results not presented).

CONCLUSION

Finally, it could be concluded from the obtained results under the experimental site and the similar condition that the optimum nitrogen level is 100 kg N/fed (25% higher than the recommended rate), the optimum seeding rate is 60 kg grains/fed, the optimum variety is Giza-171 and the optimum treatment is Giza-171 variety + 80 kg grains/fed + 100 kg N/fed.

***Table 1: Spike characters as affected by nitrogen levels* in 2018/ 2019 and 2019/2020 seasons.**

Spike characters	Nitrogen levels (Kg /fed)[1]			F-test	$LSD_{0.05}$
	60	80	100		
2018/2019 season					
Spike length (cm)	13.5	13.5	13.7	*	0.1
Number of grains/spike	63.0	70.1	68.2	*	1.5
Weight of grains/ spikes (g)	4.2	4.4	4.5	*	0.1
1000- grain weight (g)	55.0	56.6	57.2	*	0.5
2019/2020 season					
Spike length (cm)	12.1	12.2	12.3	*	0.1
Number of grains/spike	62.2	55.7	60.0	*	2.4
Weight of grains/ spikes (g)	2.3	2.4	3.0	NS	-
1000- grain weight (g)	64.8	66.6	66.7	*	1.5

1= One feddan= 4200m2 *= Significant at P < 0.05 NS = Non-significant.

Table 2: Spike characters as affected by seeding rates in 2018/ 2019 and 2019/2020 seasons.

Spike characters	Seeding rates (Kg /fed)[1]			F-test	$LSD_{0.05}$
	40	60	80		
2018/2019 season					
Spike length (cm)	13.6	13.5	13.5	NS	-
Number of grains/spike	65.0	66.6	69.8	*	3.1
Weight of grains/ spikes (g)	4.3	4.2	4.8	NS	-
1000- grain weight (g)	56.4	56.6	56.7	*	0.1
2019/2020 season					
Spike length (cm)	12.1	12.3	12.3	*	0.2
Number of grains/spike	56.9	63.1	55.8	NS	-
Weight of grains/ spikes (g)	2.2	2.3	3.4	*	1.1
1000- grain weight (g)	65.2	66.2	66.3	*	0.9

1= One feddan= 4200m2 *= Significant at P < 0.05 NS = Non-significant.

Table 3: Spike characters as affected by varieties in 2018/ 2019 and 2019/2020 seasons.

Spike characters	Varieties			F-test	$LSD_{0.05}$
	Giza-171	Gemmiza-12	Shandawil-1		
2018/2019 season					
Spike length (cm)	13.5	13.5	13.7	*	0.2
Number of grains/spike	63.0	70.1	68.2	*	1.8
Weight of grains/ spikes (g)	4.2	4.5	4.5	Ns	-
1000- grain weight (g)	57.3	56.6	55.0	*	1.5
Spike length (cm)	12.2	12.2	12.3	*	0.1
Number of grains/spike	62.3	55.7	60.0	*	2.1
Weight of grains/ spikes (g)	2.3	2.4	3.6	*	0.2
1000- grain weight (g)	66.8	66.7	64.8	*	1.9

1= One feddan= 4200m2 *= Significant at P < 0.05 NS = Non-significant.

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