J. of Plant Production, Mansoura Univ., Vol. 16 (6): 341- 348, 2025

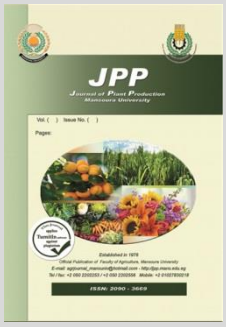
Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Effect of Planting Dates and Mineral Fertilization Levels on Growth Characteristics and Grain Quality of Some Bread Wheat Varieties

Kandil, A. A.; M. A. Badawi; S. E. Seadh* and Kholoud E. Saber

Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt



ABSTRACT

Two field experiments were conducted at a private Farm in Abu Zekry Village, Miniat El-Nasr District, Dakahlia Governorate, Egypt, during 2021/2022 seasons and 2022/2023 to study the response of three wheat cultivars (Giza 171, Sids 14, and Misr 1) to NPK fertilizers levels under different planting dates conditions to face climate changes. The field experiment was carried out in split-split plots system in a randomized complete block design in three replications. Planting wheat on 20th December produced plant height, total chlorophylls, area of the flag leaf and the number of days that can be used to reach 50% heading. The highest number of days till 50% heading, area of the flag leaf, total chlorophylls, and height of the plant. While, Sids 14 cultivar was exceeded in the percentages of grains that contain crude protein and potassium. The greatest plant height, number of days until 50% heading, area of the flag leaf, and total chlorophylls, percentages of cereals that contain crude protein and potassium were achieved by raising the amount of NPK fertilizer to 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed. From obtained results of this study and in light of the climate changes that the whole world is witnessing, as well as Egypt, Under the environmental circumstances of Miniat El-Nasr District, Dakahlia Governorate, Egypt, it is possible to induce maximum development and productivity by planting Giza 171/Misr 1 cultivars on December 20th and fertilizing with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed.

***Keywords*:** Wheat, sowing dates, Cultivars, NPK-levels.

INTRODUCTION

The most significant and extensively cultivated cereal crop in Egypt and the entire world is wheat (*Triticum aestivum* L.). In this way, wheat provides around 20% of the calories that people throughout the world consume. The primary use of wheat is as food for humans. It is nutrient-dense, portable, and simple to turn into a variety of foods, including bread, macaroni, biscuits, and sweets. Despite this, wheat can be used as animal feed.

Around 3.213 million feddan were planted with wheat in Egypt during the 2023 season, and the country produced around 9.700 million tons of wheat on average, having 20.13 ardab/fed (FAO, 2025). In Egypt, wheat output is insufficient to meet domestic demand. Much effort has been made to fulfill the ongoing demand and close the gap between wheat production and consumption, boost wheat production by either expanding the cultivated area or by optimizing yield per square meter.

The utilization of appropriate agronomic techniques has been proven to increase crop output and enable vertical development. Furthermore, the significant contribution of agronomic procedures such as choosing the most suitable date for planting, using promising cultivars and fertilizing with appropriate rates of nitrogen, phosphate and potassium fertilize, especially under climate changes.

Climate changes are affecting the plant production, including wheat growing especially in Egypt. Modifying the planting date is one of the most often used adaptations in wheat cultivation to face climate changes. The effects of all environmental conditions and edaphic components on the "planting date" are a reference to the yield and growth of every field crop, which vary greatly depending on the area. Furthermore, it is thought that the most significant influencing element for wheat and all field crops in general is the planting date. It is essential for wheat plant germination, growth, yield, and quality of characteristics. Since Egyptian conditions differed from one country to another in terms of edaphic parameters, the literature on planting dates will demonstrate how planting dates affect wheat growth yield, yield components, and grain quality (Forster *et al.*, 2017).

Selecting cultivars with great yielding potential is unquestionably crucial to increasing wheat productivity per unit area. To shed light on the best kinds that may be used in the research region's environmental conditions, this study aims to compare the new, promising varieties with the older, traditional ones.

For plants, nitrogen is frequently the most crucial nutrient because it affects the quantity of protoplasm, protein as well as chlorophyll that are produced, which in turn increases the size of cells, the area of leaves, and the activity of photosynthetic processes. The wheat crop responds well to nitrogen fertilizer and is extremely sensitive to insufficient nitrogen (David *et al.*, 2005). As a crucial agricultural nutrient, only nitrogen fertilizer is scored higher than phosphorus fertilizer. From the beginning to the conclusion of a plant's life, phosphorus plays a significant part in the cellular generation of ATP and ADP, which are essential for the metabolism of plant growth (Marschner, 2012). Potassium (K) plays several vital roles in plants, including water usage, ionic balance regulation, protein synthesis, photosynthesis, photosynthetic translocation, and stomata regulation, enzyme activation and

* **Corresponding author.**
E-mail address: seseadh04@mans.edu.eg
DOI: 10.21608/jpp.2025.391134.1473

osmoregulation (Marschner, 2012). One of the key elements influencing wheat development, yield, and quality is NPK fertilization. Therefore, one of the advantageous elements for raising wheat production and quality is using the right amount of NPK.

Therefore, this study's goal was to investigate how some contemporary bread wheat cultivars responded to varying planting dates and levels of nitrogen, phosphorus and potassium minerals (NPK) fertilizers in terms of growth, yield, and grain quality in order to adapt to climate changes in the Miniat El-Nasr District of the Dakahlia Governorate, Egypt.

MATERIALS AND METHODS

Over the course of the two successive winter seasons of 2021/2022, and 2022/2023, two field trails were conducted at a private farm in Abu Zekry Village, Miniat El-Nasr District, Dakahlia Governorate, Egypt. The main objective of these experiments was to investigate the response development and grain quality of a few contemporary cultivars of bread wheat to mineral fertilizers that contain nitrogen, phosphorus, and potassium (NPK) levels under different planting dates conditions to face climate changes.

Three replicates of the split-split plot experiment using a randomized complete block design (RCBD) were used for the field trails. There were 36 treatments in each experiment, including four dates for planting, three wheat cultivars and three amounts of mineral fertilizers that contain nitrogen, phosphorus, and potassium (NPK). The main plots of each experiment were occupied with four planting dates as follows (20th October, 10th November, 30th November and 20th December).

The following contemporary bread varieties of wheat were used to assign the sub-plots: Giza 171, Sids 14, and Misr 1. The Wheat Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt, provided the Egyptian modern bread wheat varieties that were the subject of this study.

NPK (nitrogen, phosphorus, and potassium) are three minerals fertilizer levels were randomly assigned to the sub-sub plots based on the recommended doses: 75% of the recommended doses of NPK, which is equivalent to 60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed; 100% of the recommended doses of NPK, which is equivalent to 80 kg N + 48.0 kg P_2O_5 + 24.0 K_2O/fed; and 125% of the recommended doses of NPK, which is equivalent to 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed. Following the determination of the calcium super phosphate (15.5% P_2O_5) used in the experiment was added to the soil at the previously indicated concentrations. Two equal doses of the nitrogen fertilizer, ammonium nitrate (33.5 percent N), were sprayed at the previously specified concentrations prior to the first and second irrigations. One dose of Potassium sulphate (48 percent K_2O), a potassium fertilizer, was sprayed prior to the first watering.

Every experimental unit measured as 4 × 1.25 meters, occupying an area of 5 m^2. In both seasons, rice (*Oryza sativa* L.) was the produce grown in the summer that came before it.

Prior to soil preparation, the first soil sample was chosen at random from 0 to 30 cm below the soil surface of the experimental field in order to evaluate the soil's chemical and physical characteristics in accordance with the established protocols and standard process. Page *et al.* (1982). The characteristics of these samples are detailed in Table 1.

Table 1. The mechanical and chemical evaluations of the test soil locations in the seasons of 2021–2022 and 2022–2023.

Analysis of soil		2021/2022	2022/2023
A: Mechanical analysis			
Clay (%)		50.45	50.25
Silt (%)		15.15	15.65
Sand (%)		34.40	34.10
Texture class		Clayey	
B: Analysis of chemicals			
pH		8.00	8.01
E.C. (mho/cm at 25 °C)		1.50	1.52
Organic matter (%)		1.35	1.27
C.E.C. (meq/100 g soil)		45.30	44.10
CaCO3 (%)		1.22	1.21
Total nitrogen (ppm)		42.6	40.3
Available P (ppm)		10.3	10.0
Exchangeable K (ppm)		220	216
Soluble cations (meq L^{-1})	Ca++	4.40	4.41
	Mg++	2.80	2.88
	Na+	4.80	4.81
	K+	3.00	3.1
Soluble anions (meq L^{-1})	CO3--	0.00	0
	HCO3-	0.70	0.75
	Cl-	7.90	7.95
	SO4--	6.40	6.5

Data recorded:

A. Growth characters:

1. days till the heading count reaches 50%. For each sub-sub plot heading, the number of days between planting and 50% of the plants was determined.
2. Total chlorophylls (SPAD): SPAD-502 (Minolta Co. Ltd., Osaka, Japan) was used to measure the flag leaf's total chlorophyll content.
3. Area of the flag leaf (cm^2). The formula used to calculate it was a = L × W × 0.75 (Gardner *et al*., 1985).
4. Height of plant (cm). Five plants were averaged in terms of the distance from the soil's surface to the top of the main stem spike.

B. Grains quality characters:

1. proportion of crude protein in wheat grains (%). The enhanced Kjeldahl method, which was modified from the A.O.A.C. method (2007), was utilized to measure the amount of nitrogen in wheat grains by condensing titrating in standard acid after adding the ammonia to saturated boric solution. To calculate the unprocessed protein fraction, Wheat flour's total nitrogen content was multiplied by 5.75.
2. proportion of potassium in grains (%). According to Walinga *et al*. (2013), a flame photometer was used to determine it.

All gathered data were statistically analyzed using the analysis of variance (ANOVA) method for split-split plot design, which was published by Gomez and Gomez (1984). Snedecor and Cochran (1980) stated that the LSD method was used to determine whether treatment means differences exist at the 5% probability level. For every statistical study, the analysis of variance technique was employed using the "MSTAT-C" computer software program.

RESULTS AND DISCUSSION

Effect of sowing dates:

The results scheduling in Tables 2,3 and 4 show that studied planting dates of wheat *i.e.* planting on October 20, November 10, November 30, and December 20 had a significant effect on growth parameters of wheat such as the quantity of chlorophyll in the flag leaf, its area, the plant's height, the number of days between planting and 50% of the plants heading, and the grain quality, such as the percentage of crude protein and potassium in both seasons. The late planting date of wheat (20th December) significantly recorded the most significant increases and produced the Plant height(103.46 and 104.82 cm), total chlorophylls in the flag leaf (20.30 and 21.72 SPAD), flag leaf area (31.76 and 32.27 cm^2), and the number of days from planting to 50% of the plants heading (88.96 and 91.22 days) as compared with the early planting date (20th October) or the two intermediate planting dates (10th November and 30th November) in the first and second seasons, respectively. The second-best planting date was 30th November and followed by planting on 10th November with concern its effect on all studied growth parameters of wheat for both seasons. Alternatively, the shortest period of time (67.00 and 68.71 days) between planting and 50% of plants heading, the flag leaf's total chlorophyll content (18.99 and 19.53 SPAD), area of the flag leaf (25.48 and 26.03 cm^2) and height of the plant (81.53 and 81.98 cm) were resulted from the early planting date (20th October) initial and subsequent, respectively. Generally, the differences between studied planting dates were significant in both seasons. The desirable effect on growth parameters as a result of planting wheat on late planting date (20th December) may be attributed to the appropriate environmental circumstances express as meteorological data *i.e.* maximum and minimum monthly temperature (ºC) and relative humidity (%) that shown in Table 2) during this period as a result of the climate changes observed throughout the world as well as Egypt, It promoted not only the highest possible seed germination but also quick growth and the creation of a healthy canopy capable of producing efficient photosynthesis, which is essential for triggering plant establishment and development and raising wheat growth parameters. These findings contradict those reported by Tahir *et al.* (2019), Aglan *et al.* (2020), Meleha *et al.* (2020), Singh *et al.* (2022), Elbatrawy *et al.* (2023), Ali *et al.* (2024b) and Khan *et al.* (2024).

Wheat grain quality characteristics, such as crude percentages of potassium and protein in both seasons, were considerably impacted by the planting dates, which were October 20, November 10, November 30, and December 20. The most profitable planting date was planted on 20th December (late planting) which markedly produced the maximum percentages of crude protein (12.83 and 12.86 %) and potassium (1.467 and 1.495 %) as compared with early or intermediate planting times both in the initial and subsequent. The second-best planting date was planting on 30th November and then planting on 10th November (intermediate planting) relating to its effect on grains quality characters of wheat (crude protein and potassium percentages) in both seasons. On the other hand, the lowest percentages of crude protein (8.85 and 8.85 %) and potassium (1.105 and 1.121 %) were obtained from early planting of wheat on 20th October both in the first and second seasons of this study. Planting on December 20th may have a favorable impact temperature and relative humidity, as indicated in Table 2, which encourages the production of additional photosynthetic products, translocation, and the buildup of dry matter, have an impact on the proportions of potassium and crude protein in wheat grains. These results agree with those reported by Eslami *et al.* (2014), Munsif *et al.* (2015), El-Sayed *et al.* (2018), El-Hag (2019), Shalaby *et al.* (2023) and Rashwan *et al.* (2024).

Table 2. Averages number of days to 50 % heading and total chlorophylls in flag leaf of wheat as affected by planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels as well as their interactions during 2021/2022 and 2022/2023 seasons.

Characters / Treatments	Number of days to 50 % heading (days)		Chlorophyll content (SPAD)	
	2021/2022	2022/2023	2021/2022	2022/2023
A. Planting dates:				
20th October	67.00	68.71	18.99	19.53
10th November	74.88	74.98	19.47	20.08
30th November	75.51	76.03	20.25	21.59
20th December	88.96	91.22	20.30	21.72
LSD at 5 %	0.87	0.88	0.22	0.23
B. Cultivars:				
Giza 171	80.41	81.61	20.20	21.19
Sids 14	68.97	70.01	19.23	20.19
Misr 1	80.38	81.59	19.82	20.80
LSD at 5 %	0.35	0.36	0.16	0.17
C. NPK-levels as ratio from the recommended doses:				
75%	74.72	75.84	17.93	18.82
100%	76.94	78.10	19.66	20.64
125%	78.11	79.27	21.66	22.74
LSD at 5 %	0.25	0.26	0.22	0.23
D. Interactions (F. test):				
A × B	*	*	*	*
A × C	*	*	*	*
B × C	*	*	*	*
A × B × C	*	*	*	*

Table 3. Averages of flag leaf area and plant height of wheat as affected by planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels as well as their interactions during 2021/2022 and 2022/2023 seasons.

Characters / Treatments	Flag leaf area(cm2)		Plant height(cm)	
	2021/2022	2022/2023	2021/2022	2022/2023
A. Planting dates:				
20th October	25.48	26.03	81.53	81.98
10th November	29.60	30.89	94.35	95.23
30th November	30.21	31.08	102.90	103.92
20th December	31.76	32.27	103.46	104.82
LSD at 5 %	0.17	0.18	0.16	0.15
B. Cultivars:				
Giza 171	29.80	30.65	100.69	101.67
Sids 14	28.19	28.96	90.98	91.85
Misr 1	29.79	30.58	95.01	95.94
LSD at 5 %	0.13	0.13	0.15	0.16
C. NPK-levels as ratio from the recommended doses:				
75%	27.24	27.99	93.18	94.08
100%	29.08	29.88	95.48	96.40
125%	31.47	32.33	98.02	98.98
LSD at 5 %	0.13	0.12	0.14	0.15
D. Interactions (F. test):				
A × B	*	*	*	*
A × C	*	*	*	*
B × C	*	*	*	*
A × B × C	*	*	*	*

Table 4. Averages of crude protein and potassium percentages in wheat grains as affected by planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels as well as their interactions during 2021/2022 and 2022/2023 seasons.

Characters	Crude protein (%)		Potassium (%)	
Treatments	2021/2022	2022/2023	2021/2022	2022/2023
A. Planting dates:				
20th October	8.85	8.85	1.105	1.121
10th November	9.83	9.86	1.194	1.202
30th November	12.54	12.55	1.440	1.467
20th December	12.83	12.86	1.467	1.495
LSD at 5 %	0.33	0.32	0.030	0.031
B. Cultivars:				
Giza 171	11.12	11.14	1.311	1.331
Sids 14	11.16	11.18	1.315	1.334
Misr 1	10.76	10.78	1.278	1.298
LSD at 5 %	0.31	0.32	0.028	0.029
C. NPK-levels as ratio from the recommended doses:				
75%	9.10	9.12	1.128	1.145
100%	10.62	10.64	1.266	1.285
125%	13.32	13.34	1.511	1.533
LSD at 5 %	0.27	0.26	0.025	0.024
D. Interactions (F. test):				
A × B	*	*	*	*
A × C	*	*	*	*
B × C	NS	NS	NS	NS
A × B × C	*	*	*	*

Performance of wheat cultivars:

According to the data, there were notable variations between the bread Egyptian wheat cultivars (Giza 171, Sids 14, and Misr 1) in all of the wheat growth parameters that were examined, including the number of days from planting until 50% of the plants headed, the amount of chlorophyll in the flag leaf, the area of the flag leaf, the height of the plant, and the quality of the grains, as measured by the proportions of potassium and crude protein for both seasons. The Giza 171 varieties yielded the highest total chlorophylls in the flag leaf (20.20 and 21.19 SPAD), area of the flag leaf (29.80 and 30.65 cm^2), height of the plant (100.69 and 101.67 cm), and the duration between planting and 50% plant heading (80.41 and 81.61 days) in the initial and subsequent, respectively. In contrast, the Sids 14 cultivar produced the lowest total chlorophylls in the flag leaf (19.23 and 20.19 SPAD), the smallest number of days from planting to 50% of plant heading (68.97 and 70.01 days), the smallest flag leaf area (28.19 and 28.96 cm^2), and the smallest plant height (90.98 and 91.85 cm) in the initial and subsequent, respectively. In both seasons, the Misr 1 cultivar was the second-best bead wheat cultivar in terms of growth parameters. In contrast, the Sids 14 cultivar produced the lowest total chlorophylls in the flag leaf (19.23 and 20.19 SPAD), the smallest number of days from planting to 50% of plant heading (68.97 and 70.01 days), the smallest flag leaf area (28.19 and 28.96 cm2), and the smallest plant height (90.98 and 91.85 cm) in the initial and subsequent, respectively. The genetic differences between wheat cultivars could be the cause of the variation in growth metrics. by El-Sayed *et al.* (2018), Gomaa *et al.* (2018), Hassanein *et al.* (2018), Khan *et al.* (2019), Elbatrawy *et al.* (2023), Alaamer *et al.* (2024), Ali *et al.* (2024b) and Khan *et al.* (2024). On the other hand, Sah *et al.* (2022) found that varieties had no significant effect on plant height. Grains quality characters of wheat *i.e.* crude protein and potassium percentages significantly differed due to wheat cultivars studied (Giza 171, Sids 14 and Misr 1) in both seasons. The highest percentages of crude protein (11.16 and 11.18 %) and potassium (1.315 and 1.334 %) were obtained from Sids 14 cultivar in the initial and subsequent, respectively. The second-best cultivar with concern grains quality characters of wheat was Giza 171 which produced the highest percentages of crude protein (11.12 and 11.14 %) and potassium (1.311 and 1.331%) following the Sids 14 cultivar in both seasons with few variations. Conversely, the Misr 1 cultivar yielded the lowest percentages of potassium (1.278 and 1.298%) and crude protein (10.76 and 10.78%) in the initial and subsequent, respectively. The former findings may have something to do with the genetic components of the cultivars employed. Similar results were obtained by El-Kalla *et al.* (2010), Atia and Ragab (2013), Mehasen *et al.* (2014), El-Sayed *et al.* (2018), Elbatrawy *et al.* (2023) and Rashwan *et al.* (2024).

Effect of nitrogen, phosphorus and potassium (NPK) fertilizers levels:

The three mineral fertilizer amounts that were examined were potassium, phosphorus, and nitrogen (NPK).—60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed, 80 kg N + 48.0 kg P_2O_5 + 24.0 K_2O/fed, and 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed (75, 100, and 125% of the recommended doses of NPK, respectively) were found to significantly differ in both seasons in terms of wheat growth parameters, such as plant height, entire amount of chlorophylls inside the flag leaf, area of the flag leaf, days between planting and 50% plant heading, and grain quality, including the proportion of potassium and crude protein. both in the Initially and thereafter seasons. the highest number of days from planting to 50% of plant heading (78.11 and 79.27 days), total chlorophylls in flag leaf (21.66 and 22.74 SPAD), flag leaf area (31.47 and 32.33 cm^2), and plant height (98.02 and 98.98 cm) were the results of fertilizing wheat with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed (125 percent of recommended doses of NPK). Fertilizing beet plants with 100% of the recommended doses of NPK (equal to 80 kg N + 48.0 kg P_2O_5 + 24.0 K_2O/fed) was the next best NPK fertilizer level, and it was shown to have an impact on wheat growth parameters in both seasons. In contrast, the lowest number of days from planting to 50% of plant heading (74.72 and 75.84 days), total chlorophylls in flag leaf (17.93 and 18.82 SPAD), area of the flag leaf (27.24 and 27.99 cm^2), and height of the plant (93.18 and 94.08 cm) were recorded when wheat was fertilized using 75% of the NPK dosages that are advised (equivalent to 60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed). These outcomes are explained by the low levels of exchangeable potassium, accessible phosphorus, and total nitrogen in the soil (Table 1), which were made up by applying NPK fertilizer. Nitrogen also plays a part in the production of protoplasm and chlorophyll, which improves meristematic activity and cell division. Additionally, phosphorus plays a role in generating energy for plant growth metabolism through cellular creation of

ATP and ADP. Furthermore, potassium's function in photosynthesis, photosynthate translocation, ionic balance regulation, stomata and water use regulation, enzyme activation, and osmoregulation leads to an increase in cell size, which in turn causes an increase in internode length, which in turn raises wheat growth parameters (Marschner, 2012). The earlier results are in line with those obtained by Laghari *et al.* (2010), Rahimi (2012), Meena *et al.* (2013), Youssef *et al.* (2013), Seadh (2014), Seadh and El-Metwally (2015), Seadh *et al.* (2020a), Lu *et al.* (2021), Alaamer *et al.* (2024) and Maurya and Kumar (2024). Significant effects on wheat grain quality characteristics were found in both seasons when mineral Fertilizer that contains nitrogen, phosphorus, and potassium (NPK) levels were examined. These levels included 75% of suggested NPK doses (equivalent to 60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed), 100% of suggested NPK doses (equivalent to 80 kg N + 48.0 kg P_2O_5 + 24.0 K_2O/fed), and 125% of suggested NPK doses (equivalent to 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed). It was observed that raising NPK levels to 125% of the suggested NPK dosages (equivalent to 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed) generated the most percentages of crude protein (13.32 and 13.34 %) and potassium (1.511 and 1.533 %) in the first and second seasons, respectively. Fertilizing wheat plants with 75 kg N/fed (100.0 % from recommended nitrogen fertilizer dose) came in second place following fertilization with 133.3% of the prescribed nitrogen fertilizer dose in terms of its impact on wheat grain quality characteristics in both seasons. On the other hand, fertilizing 75% of wheat plants of the authorized doses of NPK (60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed) in the Initially and thereafter seasons produced the lowest percentages of crude protein (9.10 and 9.12%) and potassium (1.118 and 1.145%). The function of NPK in promoting dry matter accumulation and growth, as well as the influence of nitrogen availability at critical phases of spike initiation and plant metabolism development, can all be used to explain the increases in wheat grain quality characteristics brought about by increased NPK fertilization application. Additionally, phosphorus plays a role in generating energy for plant growth metabolism through cellular creation of ATP and ADP. Furthermore, potassium plays a part in protein synthesis, photosynthetic translocation, photosynthesis as well as enzyme activity, all of which promote amino acid synthesis and incorporation into grain protein. The previous results align with those obtained by Youssef *et al.* (2013), Seadh (2014), Seadh and El-Metwally (2015), Seadh *et al.* (2020a), Rashwan *et al.* (2024) and Sultonov *et al.* (2025).

Effect of interactions:

The interaction between The three elements under study (planting dates, bread wheat cultivars, and nitrogen, phosphorus as well as the levels of potassium "NPK" fertilizer) had a highly significant impact on wheat growth parameters, such as plant height, entire amount of chlorophylls in the leaf of the flag , leaf of the flag area , and the length of days from planting till 50% of the plants are heading and grains quality, such as crude protein percentage and potassium percentage, for both seasons. The results revealed that delaying the sowing of the Giza 171 cultivar until December 20th and fertilizing with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed (125 percent of the suggested dosages of NPK) for both seasons resulted in total chlorophylls in the flag leaf, flag leaf area, plant height, and the maximum number of days from planting to 50% of plant heading (Tables 5, 6 and 7). Based on the impact on wheat growth parameters in both seasons, this interaction treatment was followed by postponing the sowing of the Misr 1 cultivar until December 20th and fertilizing with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed. However, early sowing of the Sids 14 cultivar on October 20th and fertilization with 60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed (75 percent of suggested dosages of NPK) resulted in the shortest height of plant, total chlorophylls in the flag leaf, the leaf of flag area, and the number of days from planting to 50% of the plant heading. The results of Rashwan *et al*. (2024) are in good agreement with this trend of results.

Table 5. Averages number of days to 50 % heading and total chlorophylls in flag leaf of wheat as affected by the interaction among planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels during 2021/2022 and 2022/2023 seasons.

Planting dates	Cultivars	NPK-levels	Number of days to 50% heading (days)		Chlorophyll content (SPAD)	
			2021/ 2022	2022/ 2023	2021/ 2022	2022/ 2023
20th October	Giza 171	75 %	84.33	84.90	18.00	18.56
		100 %	86.00	86.60	19.70	20.31
		125 %	87.66	88.26	21.50	22.12
	Sids 14	75 %	56.33	56.73	16.76	17.28
		100 %	58.00	58.40	18.60	19.17
		125 %	58.66	59.06	20.33	20.96
	Misr 1	75 %	80.66	81.16	17.86	18.42
		100 %	83.66	84.23	19.63	20.24
		125 %	84.33	84.93	21.10	21.75
10th November	Giza 171	75 %	70.66	72.46	19.60	20.16
		100 %	73.33	75.23	20.40	20.98
		125 %	74.00	75.90	22.60	24.04
	Sids 14	75 %	60.66	62.20	16.06	16.53
		100 %	62.66	64.26	17.60	18.10
		125 %	63.33	64.93	19.50	20.06
	Misr 1	75 %	65.33	67.03	17.30	17.79
		100 %	66.33	68.03	18.60	19.13
		125 %	66.66	68.36	20.36	20.95
30th November	Giza 171	75 %	75.33	75.43	18.60	19.78
		100 %	77.33	77.43	21.26	22.62
		125 %	78.33	78.43	22.33	23.95
	Sids 14	75 %	70.33	70.43	18.23	19.39
		100 %	73.66	73.76	19.66	20.92
		125 %	75.66	75.76	21.23	22.58
	Misr 1	75 %	71.33	71.43	18.30	19.46
		100 %	74.66	74.76	20.30	21.59
		125 %	77.33	77.43	22.50	23.93
20th December	Giza 171	75 %	90.66	92.96	18.60	19.94
		100 %	93.00	95.36	20.33	21.80
		125 %	94.00	96.40	23.50	25.20
	Sids 14	75 %	80.66	82.70	17.56	18.84
		100 %	82.33	84.43	19.60	21.01
		125 %	83.66	85.76	21.73	23.30
	Misr 1	75 %	90.33	92.63	18.33	19.66
		100 %	92.33	94.66	20.30	21.77
		125 %	93.66	96.06	23.30	24.02
LSD at 5 %			0.89	0.91	0.77	0.80

Table 6. Averages of flag leaf area and plant height of wheat as affected by the interaction among planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels during 2021/2022 and 2022/2023 seasons.

Planting dates	Cultivars	NPK-levels	Flag leaf area (cm^2)		Plant height (cm)	
			2021/2022	2022/2023	2021/2022	2022/2023
20th October	Giza 171	75 %	25.80	26.33	90.53	91.03
		100 %	26.43	27.00	91.26	91.76
		125 %	27.83	28.43	95.33	95.83
	Sids 14	75 %	22.33	22.80	70.40	70.80
		100 %	24.60	25.13	72.46	72.86
		125 %	27.46	28.03	74.26	74.66
	Misr 1	75 %	22.56	23.06	77.33	77.73
		100 %	24.70	25.20	79.73	80.20
		125 %	27.66	28.26	82.46	82.96
10th November	Giza 171	75 %	30.66	31.56	90.20	91.00
		100 %	31.60	32.50	99.60	100.50
		125 %	34.30	35.26	102.26	103.26
	Sids 14	75 %	26.46	27.20	98.33	99.23
		100 %	26.73	27.50	90.20	91.00
		125 %	30.60	31.50	92.40	93.30
	Misr 1	75 %	28.23	29.03	88.50	89.30
		100 %	30.46	31.36	92.26	93.16
		125 %	32.86	33.83	95.40	96.30
30th November	Giza 171	75 %	31.43	32.80	101.20	102.20
		100 %	34.23	35.76	103.46	104.46
		125 %	34.73	35.30	107.20	108.30
	Sids 14	75 %	25.26	26.36	90.40	91.60
		100 %	27.40	28.60	92.46	93.66
		125 %	29.00	30.23	94.06	95.26
	Misr 1	75 %	25.80	26.90	101.40	102.73
		100 %	28.66	29.96	104.33	105.73
		125 %	29.80	31.10	106.33	107.73
20th December	Giza 171	75 %	32.43	32.96	107.06	108.16
		100 %	35.26	35.80	111.20	112.70
		125 %	36.36	36.93	115.83	117.33
	Sids 14	75 %	27.76	28.20	98.20	99.20
		100 %	28.43	28.90	102.36	103.36
		125 %	32.26	32.76	103.66	104.66
	Misr 1	75 %	28.20	28.66	100.50	101.50
		100 %	30.43	30.93	102.46	103.46
		125 %	34.80	36.30	115.16	116.66
LSD at 5 %			0.47	0.48	0.49	0.51

The study found that the three factors—planting dates, bread wheat cultivars, and the amounts of nitrogen, phosphorus, and potassium "NPK" fertilizers—interacted to significantly change the wheat grain quality attributes in both seasons, including the percentages of crude protein and potassium. According to the results, the Sids 14 cultivar was sown on December 20th and fertilized with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed (125 percent of suggested dosages of NPK) in the Initially and thereafter seasons, respectively, yielding the highest percentages of crude protein (15.83 and 1 5.87 percent) and potassium (1.739 and 1.773 percent) (Table 7). Regarding its impact on the grain quality characteristics of wheat in both seasons, this interaction treatment was followed by postponing the sowing of the Sids 14 cultivar to November 30 and fertilizing with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed. However, early sowing of the Misr 1 cultivar on October 20th and fertilization with 60 kg N + 36.0 kg P_2O_5 + 18.0 K_2O/fed (75 percent of suggested dosages of NPK) produced the lowest percentages of crude protein (6.93 and 6.94 percent) and potassium in the Initially and thereafter seasons, respectively, at 0.930 and 0.944 percent. Similar outcomes were noted by Rashwan *et al.* (2024).

Table 7. Averages of crude protein and potassium percentages in wheat grains as affected by the interaction among planting dates, bread wheat cultivars and nitrogen, phosphorus and potassium (NPK) fertilizers levels during 2021/2022 and 2022/2023 seasons.

Planting dates	Cultivars	NPK-levels	Crude protein (%)		Potassium (%)	
			2021/2022	2022/2023	2021/2022	2022/2023
20th October	Giza 171	75 %	7.07	7.08	0.943	0.956
		100 %	7.35	7.35	0.968	0.982
		125 %	11.26	11.26	1.324	1.343
	Sids 14	75 %	7.10	7.11	0.946	0.959
		100 %	9.37	9.38	1.152	1.169
		125 %	12.35	12.36	1.423	1.443
	Misr 1	75 %	6.93	6.94	0.930	0.944
		100 %	7.25	7.26	0.960	0.973
		125 %	10.97	10.98	1.297	1.316
10th November	Giza 171	75 %	7.25	7.28	0.960	0.966
		100 %	8.48	8.51	1.071	1.078
		125 %	12.96	13.00	1.478	1.488
	Sids 14	75 %	7.39	7.42	0.972	0.979
		100 %	10.35	10.38	1.241	1.250
		125 %	13.82	13.86	1.557	1.567
	Misr 1	75 %	7.09	7.11	0.944	0.951
		100 %	8.37	8.40	1.061	1.068
		125 %	12.79	12.83	1.463	1.473
30th November	Giza 171	75 %	11.23	11.26	1.321	1.346
		100 %	13.14	13.18	1.495	1.524
		125 %	13.52	13.55	1.529	1.558
	Sids 14	75 %	13.07	13.10	1.488	1.517
		100 %	14.01	14.04	1.573	1.604
		125 %	14.47	14.49	1.615	1.645
	Misr 1	75 %	9.40	9.42	1.155	1.176
		100 %	11.96	11.99	1.388	1.415
		125 %	13.22	13.25	1.502	1.531
20th December	Giza 171	75 %	11.56	11.58	1.352	1.377
		100 %	12.41	12.43	1.428	1.455
		125 %	14.33	14.35	1.603	1.632
	Sids 14	75 %	11.60	11.61	1.354	1.379
		100 %	13.35	13.37	1.513	1.541
		125 %	15.83	15.87	1.739	1.773
	Misr 1	75 %	9.54	9.56	1.168	1.190
		100 %	11.41	11.43	1.338	1.362
		125 %	14.31	14.33	1.601	1.631
LSD at 5 %			0.95	0.93	0. 087	0.088

CONCLUSION

Based on the study's findings and the global and Egyptian climate shifts, it is recommended that Giza 171 or Misr 1 cultivars be sown on December 20 and fertilized with 100 kg N + 60.0 kg P_2O_5 + 30.0 K_2O/fed to achieve maximum development potential and productivity in the Miniat El-Nasr District of the Dakahlia Governorate, Egypt.

REFERENCES

A.O.A.C. (2007). Official Methods of Analysis. 18th Ed. Association of Official Analytical Chemists, Inc., Gaithersburg, MD, Method 04.

Aglan, M. ; A. El-Hamid and A.M. Abd Morsy (2020). Effect of sowing date on yield and its components for some bread wheat genotypes. Zagazig J. of Agric. Res., (1)1-12.

Alaamer, S.A. ; N. Shtewy and S.K.A. Alsharifi (2024). Wheat response to the nitrogen fertilizers in productivity. Sabrao J. of Breeding and Gen., 56 (6): 2532-2543, doi.org/10.54910/sabrao2024. 56.6.35.

Ali, E.A. ; S.F. Abou-Elwafa ; M.N.T. Abd El-Kader and R. Ahmed (2024b). Evaluation of grain yield and its attributes in bread wheat cultivars under heat stress conditions. Assiut J. of Agric. Sci., 55(3): 1-16.

Atia, R.H. and Kh.E. Ragab (2013). Response of some wheat varieties to nitrogen fertilization. J. Soil Sci. and Agric. Eng., Mansoura Univ., 4(3): 309-319.

David, C. ; M.H. Jeuffroy and J.M. Meynard (2005). Nitrogen management of organic winter wheat Decision-making through model-based explorations. Res. Sust. Sys., Intern. Sci. Conf. on Organic Agric., Adelaide, Australia, Sept. 21-23, 2005.

Elbatrawy, W. S. ; A. Kishk and H.E. Ghanem (2023). Effect of sowing dates on productivity and seed quality on some wheat varieties. Egyptian J. of Agric. Res., 101(2): 497-504.

El-Hag, A.A. Dalia (2019). Performances of some wheat cultivars to sowing late in North Delta. Plant Production, Mansoura Univ., 9(3) 233-239.

El-Kalla, S.E. ; A.A. Leillah ; M.I. El-Emery and A.M.S. Kishk (2010). Performance of some wheat (*Triticum aestivum* L.) cultivars under late sowing in newly reclaimed soils. J. Plant Production, Mansoura Univ., 1(5): 689-697.

El-Sayed, Soad, A. ; Eman, N.M. Mohamed ; Dalia A.A. El-Hag and Amany, M. Mohamed (2018). Sowing dates effect on yield and grain quality of some wheat cultivars. J. Plant Production, Mansoura Univ., 9(2): 203-213.

Eslami, H. ; S.M.J. M. Hadi and M.K. Arabi (2014). Effect of planting date on protein content of wheat varieties. Intern. J. Farm. & Alli. Sci., 3 (4): 362-364.

FAO (2025). Food and Agriculture Organization. Faostat, FAO Statistics Division, May 2025, http://www.fao.org/faostat/en/#data /QC.

Forster, S.M. ; J.K. Ransom ; F.A. Manthey ; J.R. Rickertsen and G.H. Mehring (2017). Planting date, seeding rate, and cultivar impact agronomic traits and semolina of durum wheat. American J. of Plant Sci., 8(9): 2040-2055.

Gardner, F.P. ; R.B. Pearce and R.L. Michell (1985). Physiology of crop plant. Iowa State Univ. Press Ames. Iowa. USA pp. 58-75.

Gomaa, M.A. ; F.I. Radwan ; E.E. Kandil and M.A.F. Al-Msari (2018). Response of some Egyptian and Iraqi wheat cultivars to mineral and nanofertilization. Egypt. Acad. J. Bio. Sci., 9(1):19-26.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Ed., Jhon Wiley and Sons Inc., New York, pp: 95-109.

Hassanein, M.S. ; Amal, G. Ahmed and Nabila, M. Zaki (2018). Effect of nitrogen fertilizer and bio-fertilizer on yield and yield components of two wheat cultivars under sandy soil. Middle East J. of App. Sci., 8(1): 37-42.

Khan, F.U. ; M. Khan ; S.G. Khattak ; Z. Iqbal ; J. Iqbal and Z. Saleem (2019). Performance of some improved bread wheat varieties grown in Khyber Pakhtunkhwa, Pakistan. Adv. Plants Agric. Res., (1):191-193.

Khan, S. ; H.P. Agrawal ; D. Pandey ; A.P. Agrawal ; N.K. Chaure ; G. Sharma ; K.L. Sahagal ; N.K. Verma ; C.R. Patel ; M.K. Patel ; A. Gendlal and V.K. Gupta (2024). Performance of wheat varieties at different dates of sowing under Chhattisgarh plain. Intern. J. of Chem. Studies, 12(4): 60-63.

Laghari, G.M. ; F.C. Oad ; S.D Tunio ; A.W. Gandahi ; M.H. Siddiqui ; A.W. Jagirani and S.M. Oad (2010). Growth yield and nutrient uptake of various wheat cultivars under different fertilizer regimes. Sarhad J. Agric., 26(4): 489-497.

Lu, J. ; T. Hu ; C. Geng ; X. Cui ; J. Fan and F. Zhang (2021). Response of yield, yield components and water-nitrogen use efficiency of winter wheat to different drip fertigation regimes in Northwest China. Agric. Water Man., 255, 107034.

Marschner, H. (2012). Mineral nutrition of higher plants. Academic press San Diego, USA

Maurya, D.K. and M. Kumar (2024). Effect of nitrogen and phosphorus fertilization on the growth and yield of wheat (*Triticum aestivum* L.). Intern. J. Environ. Climate Change, 14(1): 552-557.

Meena, V. ; S.B.R. Maurya ; R. Verma ; R. Meena ; R.S. Meena ; G.K. Jatav and D.K. Singh (2013). Influence of growth and yield attributes of wheat (*Triticum aestivum* L.) by organic and inorganic sources of nutrients with residual effect under different fertility levels. The Bioscan, 8(3): 811-815.

Mehasen, S.A.S. ; N.Kh. El-Gizawy ; A.M. Sharoba ; S.A. Soliman and T.R.M. Khalil (2014). Yield and chemical composition of bread wheat cultivars as affected by some skipping irrigation. Minufiya J. Agric., 39 (3):1-6.

Meleha, A.M. ; A.F. Hassan ; M.A. El-Bialy and M.A. El-Mansoury (2020). Effect of planting dates and planting methods on water relations of wheat. Intern. J. of Agron., 1, 8864143.

Munsif, F. ; M. Arif ; K. Ali ; M.T. Jan and M.J. Khan (2015). Influence of planting dates on grain quality of different wheat cultivars in dual purpose system. Intern. J. Agric. Biol., 17(5): 945-952.

Page, A.L. (1982). Methods of soil analysis, Part 2, chemical and microbical properties (2nd Ed.). American Society of Agronomy. In Soil Sci. of Amer. Inc. Madison Wisconsin, USA.

Rahimi, A. (2012). Effect of potassium and nitrogen on yield and yield components of dry land wheat in Boyerahmad Region of Iran. Annals of Biol. Res., 3 (7): 3274-3277.

Rashwan, E.A. ; W.Z.E. Farhat ; H.M. Abdel-Lattif and M.I. Elgendy (2024). Response productivity and grain quality of new wheat cultivars to seeding rates and nitrogen levels under different sowing dates. Egypt. J. Agron., 46(1): 61-73.

Sah, M.K. ; A. Shrestha ; P. Shah ; R.P. Yadav ; B.P. Yadav and A. Mishra (2022). Impact of sowing dates on wheat varieties in central Terai region of Nepal. Agron. J. of Nepal, 6(1):162-169.

Seadh, A.K.E.G. (2014). Improvement of some wheat varieties productivity under organic and minerals fertilization. Ph. D. Thesis, Fac. of Agric. Mansoura Univ., Egypt.

Seadh, S.E. ; A.Y. El-Khateeb ; A.M.A. Salama and A.M.S.A. Mohamed (2020a). Effect of chelated and nano zinc foliar application and nitrogen fertilizer levels on growth and grains quality of wheat. The 16th Intern. Conf. of Crop Sci., Agron. Dept., Fac. Agric, Cairo., Al-Azhar Univ., Oct. 13, 2020, pp: 480-494.

Seadh, S.E. and M.A. El-Metwally (2015). Influence of antioxidants on wheat productivity, quality and seed-borne fungi management under NPK fertilization levels. Asian J. of Crop Sci., 7(2): 87-112.

Shalaby,N.E. ; S.A. Abdelkhalik ; K.I.Gad and B.E. Elsamahy (2023). Effect of sowing date on grain yield and quality of some Egyptian bread wheat genotypes. Egyptian J. of Agric. Res., 101(2): 643-652.

Singh, P.K. ; S.K. Singh and S. Vivekanand (2022). Effect of different sowing dates and cultivars on growth, yield and economics of wheat (*Triticum aestivum*) under mid land situation. The Pharma Inn. J., 10(8): 339-342.

Snedecor, G.W. and W.G. Cochran (1980). "Statistical Methods" 7th Ed. The Iowa State Univ. Press, Iowa, USA.

Sultonov, K. ; G. Kholmurodova ; J. Eshonkulov ; K. Allanov ; O. Sindarov ; K. Khayitov ; J. Khaitbaeva ; S. Salomov ; S. Isaev ; A. Djumanazarova ; R. Imyaminova ; N. Jurayeva ; M. Karimova ; L. Khayrullaeva ; N. Yakubjonova ; N. Durdiev ; R. Yuldasheva and B. Khaitov (2025). Effect of integrative NPK soil and foliar nutrition on winter wheat (*Triticum aestivum* L.) productivity in irrigated arid lands. Front. Sustain. Food Syst., 8: 1508913, doi: 10.3389/fsufs.2024.1508913.

Tahir, S. ; A. Ahmad ; T. Khaliq and M.J.M. Cheema (2019). Evaluating the impact of seed rate and sowing dates on wheat productivity in semi-arid environment. Intern. J. Agric. Bio., 22(1): 57-64.

Walinga, I. ; J.J. Van-Der-Lee ; V.J. Houba ; W. Van-Vark and I. Novozamsky (2013). Plant analysis manual. Springer Science & Business Media.

Youssef, S.M. ; S.E.D. Faizy ; S.A. Mashali ; H.R. El-Ramady and Sh. Ragab (2013). Effect of different levels of NPK on wheat crop in North Delta. Jahrestagung der Deutschen Bodenkundlichen Gesellschaft vom 07. Bis 12. September 2013 in Rostock; Vorträge Kommission IV, Berichte der DBG (nicht begutachtete online-Publikation).

تأثير مواعيد الزراعة ومستويات التسميد المعدني على صفات النمو وجودة الحبوب لبعض أصناف قمح الخبز

أحمد أبو النجا قنديل، محسن عبد العزيز بدوي، صالح السيد سعده وخلود السيد صابر

قسم المحاصيل، كلية الزراعة، جامعة المنصورة، مصر.

الملخص

أُجريت تجربتان حقليتان في مزرعة خاصة بقرية أبو ذكري، مركز منية النصر، محافظة الدقهلية، خلال موسمي ٢٠٢١/٢٠٢٢ و٢٠٢٢/٢٠٢٣ بهدف دراسة استجابة النمو وجودة الحبوب لبعض أصناف قمح الخبز المصرية الحديثة لمواعيد الزراعة ومستويات الأسمدة المعدنية النيتروجينية والفوسفاتية والبوتاسية وذلك لمواجهة التغيرات المناخية. أُجريت التجارب الحقلية في تصميم القطع المشقة مرتين بنظام القطاعات الكاملة العشوائية في ثلاث مكررات. نتج عن الزراعة المتأخرة للقمح في ٢٠ ديسمبرأكبر الزيادات معنويًا وأنتج أعلي عدد الأيام من الزراعة حتى طرد ٥٠٪ من السنابل، محتوي الكلوروفيل الكلي بورقة العلم، مساحة ورقة العلم، ارتفاع النبات، النسبة المئوية للبروتين الخام والبوتاسيوم في الحبوب. تم الحصول على أعلى عدد الأيام من الزراعة حتى طرد ٥٠٪ من السنابل، محتوي الكلوروفيل الكلي بورقة العلم، مساحة ورقة العلم، ارتفاع النبات من صنف جيزة ١٧١ في كلا الموسمين. بينما تفوق صنف سدس ١٤ في النسبة المئوية للبروتين الخام والبوتاسيوم في الحبوب. نتج عن زيادة مستويات الأسمدة المعدنية النيتروجينية والفوسفاتية والبوتاسية (NPK) حتى ١٠٠ كجم N + ٦٠ كجم P_2O_5 + ٣٠ كجم K_2O/فدان أعلى عدد الأيام من الزراعة حتى طرد ٥٠ % من السنابل، محتوى الكلوروفيل الكلي بورقة العلم، مساحة ورقة العلم، ارتفاع النبات، النسبة المئوية للبروتين الخام والبوتاسيوم في الحبوب. يمكن الاستنتاج أن زراعة صنف القمح جيزة ١٧١ أو مصر ١ في يوم ٢٠ ديسمبر وتسميده بـ ١٠٠ كجم نيتروجين + 60.0 كجم فو٢أ٥ + 30.0 كجم بو٢أ/فدان وذلك للحصول على أقصى نمو وإنتاجية تحت الظروف البيئية لمنطقة منية النصر، محافظة الدقهلية، مصر.