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INFLUENCE OF PLANTING DATES AND NITROGEN FERTILIZATION LEVELS ON GROWTH AND GREEN FORAGE YIELD OF SORGHUM HYBRID

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ABSTRACT

This investigation was conducted in a private farm at two field experiments in research farm of the Agricultural Research Center in the Sakha, Kafr El Sheikh Governorate, Egypt, under Agronomy branch supervision, Plant Production Department, Faculty of Technology & Development, Zagazig University, during the two successive summer seasons 2022 and 2023. This investigation aimed to study the effect of four planting dates T1 (1st may), T2 (15th May), T3 (1st June) and T4 (15th June) with four nitrogen fertilization levels (without N (N1), 20 kg N/fad. (N2), 30kgN/Fad. (N3) and 40 kg N/fad. (N4) on growth and green forage yield of Sorghum hybrid. A split-plot design with three replications was used in both growing seasons. The most important findings could summarized as follows:

***The results showed that** planting date in 1st May ted to a significant increase in total fresh forage yield / fad. This increase compared to other planting dates (15 May, 1 Joune, and 15 Joune) amounted to in the first season by 1.26% 15.9% and 25.75% and 37.78 , 52.73% and 80.12% in the second season and 10.80%, 14.55and 33.88% in the combined respectively. Also planting date in 1st May resulted significant increase in plant height, no of tillers, no of leaves / plant, fresh leaves/stem ratio and stem diameter.*

Increasing nitrogen level up to 40 kg /N fad. increase in total fresh forage yield fad. This increase compared to other nitrogen fertilization levels (0, 20 and 30 kg/fad.) amounted to in the first season by 60.59%, 26.03% and 11.81% and 62.61% 24.54% and 9.57% in the second season and 62.71%, 25.21% and 10.61% in the combined, respectively. Moreover, these results showed that increasing N-level from 0 up to 40 kg/fad. produced gradual and significant increases in plant height, no. of tillers, no of leaves / plant, fresh leaves/stem ratio, and stem diameter. Regarding the interaction effect, the treatments of sowing date in 1" May and nitrogen fertilization levels of 40 kg fad were recorded the highest values of most studied characters in this respect.

Conclusively, *these results of this study recommended by the planting sorghum hybrid in 1th May and fertilizing with 40 kg N / fad. under condition of Kafr El- Sheikh Governorate , Egypt.*
Key words: sorghum, sowing dates, nitrogen fertilization levels.

INTRODUCTION:

The fodder sorghum crop is a green summer fodder resulting from the hybridization of sorghum and sudan grass. This hybrid is characterized by abundant branching, large leaf area, and increased yield, reaching (45-50 tons/fad.) per season, and also an increase in its protein content from (10-14%). It is offered to livestock either in fresh, green form (mowed, grazed) or preserved in the form of hay. The nutritional value varies according to the age of the plant, as the percentage of protein decreases, the percentage of fiber increases, and animal appetite, palatability, and the amount of digested matter decrease as the plant ages. It is taken from 3-4 cuttings per season, and it may reach five cuttings in the case of early planting the first of May **(TAGEPEDIA, 2024).** Sorghums are warm-season (c4 photosynthesis bath way) short-day annual grass it grows best under relatively high temperature and under gunny conditions sorghums as a crop originated as far back as 3000 years ago. Forage sorghums is similar to grain types early times was for grain more than forage, however, forage varieties have been occurring for the last hundred years, forage sorghum is similar to grain types but is taller and has higher forage quality, the forage sorghums are further grouped into four types (a) hybrid forage sorghum, (b) Sudan grass, (c) sorghum Sudan grass hybrid (also known as Sudan grass hybrids), and (c) sweet sorghum. Sorghum, Sorghum bicolor L., is an important fodder crop for both arid and semi-arid regions of the world. This importance is due to its higher water use efficiency, relatively good tolerance to drought and salt stresses, potential for tilling in high amounts, and good competitiveness with weeds in advanced growth stages.

Planting date has a key role in establishment the crop especially in mild cold areas, where sorghum is damaged from early or late sowing dates. In such as climatic conditions, proper nitrogen application has an important role for fast growth and green forage production too.

Increasing productivity can be achieved in several ways, including planting dates and adding fertilizers to plants to increase green forage productivity and its quality.

Alcântara *et al.* (2011) evaluated the effect of sowing dates of hybrid silage sorghum and found that the sowing dates caused changes in the green and dry mass yield, with decreasing yields as the sorghum sowing time was delayed. Also, he found that the lowest value observed in the last sowing date.

Raei *et al.* (2014) evaluated the effect of plant density and sowing date on forage Sorghum. He found it the highest and the lowest forage dry weight was achieved from sowing date of 23 July and 2 August, respectively. Stem diameter and the number of tiller per plant were significantly redacted as sowing date was delayed. With early planting, leaf to stem dry weight ratio was significantly increased.

Joorabi *et al.* (2015), report that planting date of June 10th gave the highest values of forage yield compared to planning dates of June 26th and July 11th. **Khatana *et al.* (2020)** studied the effect of sowing dates on sorghum (11th June, 26th June and 10th July), He found that the crop sown on 11th June and 26th June recorded significantly higher plant height, dry matter accumulation and leaf area index as compared to 10th July sowing. Sowing of 11th June and 26th June also recorded significantly higher green fodder yield was also found higher in the first two sowings. These results are in agreement with those obtained by **Oberoi *et al.* (2021), Mahalle *et al.* (2022) and Dakshayani *et al.* (2023). Shakil *et al.* (2023)** in Pakistan studied the forage sorghum under five dates of sowing (1st February, 15th February, 1st March, 15th March and 1st April) during 2018 as well as 2019 at Faisalabad. The line AK-113 showed the highest green fodder yield as an average of 3 cuts on the 15th of March during 2018 as well as 2019. In addition, green fodder yield as average of 3 cuts (tons/ha) were increased gradually with delaying planting date from 1st February to 1st April in the two seasons.

Nitrogen is an important nutrient because of its many functions in the vital processes of plant growth and development. Nitrogen deficiency imposes most limits on crop production compared to other nutrients.

Sorghum yield and its attributed physiological properties are significantly affected by nitrogen fertility. Nitrogen fertilizer application increases forage yield and its quality **(Ashiono *et al.*, 2005; Gardner *et al.*, 1994; Jarvis, 1996).** Several reports showed that sorghum had severed reaction to nitrogen fertility on sorghum reported that highest yield was produced by application 125kg nitrogen per hectare. **Restelatto *et al.* (2015)** evaluated forage sorghum (*Sorghum bicolor*) (*Avena strigosa)* under nitrogen fertilization in Brazil, in Rhodic Hapludox soil. Treatments included 0, 37.5, 75, 150, 225, 300, and 375 kg Nha^{-1} in the summer seasons of 2010/2011 and 2011/2012. The highest sorghum forage production and N extraction were under 230 to 300 kgNha^{-1}. **Ahmadi *et al.* (2016)** investigated the effects of cultivars in Iran, during 2010-11 cropping season. Four levels of nitrogen fertilizer (0, 50, 100 and 150 kg ha^{-1}) were used. Increasing nitrogen levels increased the values of forage yield. The highest forage yield was obtained with 150 kg/ ha^{-1} nitrogen at first harvesting time. **Noori (2020)** found that the N fertilization significantly increased all growth parameters and forage yield of sorghum over control.,

application of 100 kg/ha^{-1} significantly enhanced the growth parameters such as dry matter accumulation and Forage yield was significantly enhanced with an increase in level of N fertilization and application of 100 kg/ha^{-1} resulted in the production of highest forage yield. **Farhadi *et al.* (2023)** evaluated the effects of different levels of nitrogen fertilizer on the sorghum forage yield and quality. Use nitrogen fertilizer application from urea source at four levels (0, 150, 300, and 450 kg ha-¹).The effect of nitrogen fertilizer was significant on the forage yield, plant height of sorghum forage.

Therefore, this study aims to investigate the effect of sowing dates and nitrogen fertilization levels on growth and green forage yield sorghum hybrid under Egyptian conditions.

MATERIALS AND METHODS

This investigation was conducted at two field experiments in research farm of the Agricultural Research Center in the Sakha, Kafr El- Sheikh Governorate, Egypt, under Agronomy branch supervision, Plant Production Department, Faculty of Technology & Development, Zagazig University, during the two successive seasons 2022 and 2023.

This investigation aimed to study the effect of four planting dates and four levels nitrogen fertilization on growth characteristics, forage yield of Sorghum hybrid.

Soil preparation:

The soil of the experimental site is clay in texture The mechanical and chemical analysis of soil at the planting depth in the two growing seasons are given in Table (1).

Factors under study:

1-Planting dates: four planting dates were studied:

a) 1st May b) 15th May c) 1st June d) 15th June

.2-Nitrogen fertilization: four levels nitrogen fertilization were applied:

a) Zero (control) b) 20 kg N/fad c) 30 kg N/fad. d) 40 kg/fad.

Experimental design:

The split plot design as a form of the randomized complete block design with three replications was followed in two seasons. Since, planting dates treatments were allotted in the main plots, while the four nitrogen fertilizer levels were arranged at random in the sub plots. Each sub- plot area was 9 m² [3 x 3 m]. The plot contained 6 rows 50 cm apart and the three meters in length.

Table (1): Some physical and chemical properties of the experimental sites at 30 cm soil depth (in the two seasons)

Soil Content	First Season (2022)	Second Season (2023)
Mechanical analysis :		
Sand %	14.02	13.46
Silt %	28.79	25.83
Clay %	57.19	60.71
Soil texture	Clay	Clay
Chemical analysis :		
pH	7.99	8.03
Ec dS / m	0.93ds/m	0.96 ds/m
O.M %	1.35	1.47
Available N (mg/kg)	30.01	29.75
Available P (mg/kg)	9.59	9.13
Available K (mg/kg)	321	297
Available Zn (mg/kg)	0.27	0.23

Notes 1- Soil analysis were done using representative composite samples.
2- Extraction solution of available N (KCl), P (Na-bicarbonate), K (NH_4-acetate) .

Cultural practices:

The preceding crop was wheat in both growing seasons, sorghum hybrid (Sakha 1) cultivar seeds were drilled in rows on 1st May, 15th May, 1st June and 15th June in both successive growing seasons 2022 and 2023 Seeding rate was 15 kg. per fad. Seeds of sorghum hybrid (Sakha 1) were obtained from Forage Crops Department, Agriculture Research Center ministry of Agriculture, Egypt. Nitrogen fertilizer was added at three equal doses one third was added two week after sowing, the second dose was added after the first cutting and the third dose was added after the second cutting. Seeds were sown in rows. All other agronomic practices were applied as recommended for this crop.

Three cuts were taken during each growing season; first cutting was taken at 60 days after sowing, the second cutting at 50 days from the first one and third cutting was taken after 45 days from the second one At each cutting five surrounded plants were taken randomly from outer two rows to determine vegetative growth parameter as an average per plant.

Data recorded:

1-Plant height (cm.). 2-Number of tillers/plant. 3-Number of leaves/plant. 4-Fresh leaves/stem ratio. 5-Stem diameter (cm.). 6-Total fresh forage yield (ton/fad.).

Statistical analysis:

The proper statistical analysis of spilt plot design was used combined analysis was performed for the characters recorded in both seasons. The collected data were statistically analyzed using the Analysis of Variance **(ANOVA)** to detect significance if any at treatment level.

Differences among treatments were judged according to **Duncan (1955).** Means followed by different letters were statistically significant. small and capital letters were used to compere values of the interaction and average, respectively.

RESULTS AND DISCUSSION:

Data in Tables 2,3,4,5,6 and 7 show that plant height, no. of leaves/plant, fresh leaves/stem ratio, no. of tillers/ plant, stem diameter and total fresh forage yield (ton/fad.) significantly affected by planting dates. Planting took place on 1st may since.

1-Plant height (cm.):

The differences in plant height (cm) between the 15th May and 1st June planting dates were not significant in the first, second and third cut This was true in the three cuts in average of the two seasons and combined. However, plant height decreased consistently and significantly as planting was delayed from 1st may to 15th June in the 3rd cuts in the two seasons. These results might be explained by that the earlier the sowing was conducted, the more suitable condition particularly climates for sorghum growth were prevailing While the planting date of 1st May gave the highest plants. Here, as mentioned before, the more favorable prevailing contestations during may planting resulted in a high germination percentage and more vigorous seedling hence, a good planting density, establishment and growth were obtained **by Al-Dulami and Al-Fahdoy (2011), Karhal *et al.* (2014, Rafee (2018), Jung *et al.* (2019) Khatana *et al.* (2020) and Shakil *et al.* (2023).**

The results presented in Table (2) show also, that the differences among nitrogen fertilization rates over the four sowing dates studied in plant height, were significant and to 40 kg N/fad. had always the greatest and highest plant height followed by 0, 20 and 30 kg N/fad. The increase in growth, plant height might be attributed to increase photosynthetic and meristematic activities of plant and improvement in the synthesis of protein and amino acids in the presence of adequate available N supply. The findings are in close conformity with **Sharma and Agrawal, (2002).** The highest gross and net monetary returns and benefit costratios were also obtained at 40kg N/fad., reported by **Joorabi *et al.* (2015), Ahmidi *et al.* (2016), Norri (2020), Mohammad *et al.* (2022) and Farhadi *et al.* (2023).**

The interaction effect between sowing dates and nitrogen fertilization

Table (2): Effect of Sowing dates , Nitrogen fertilization rates and their interaction on(Plant height (cm). in both seasons (2022 and 2023) and combined.

Items	Levels nitrogen (kg/fad).														
	2022 season					2023 season					Combined				
	0	20	30	40	Average	0	20	30	40	Average	0	20	30	40	Average
	1stcut														
1st May	169.96 k	195.33d	206.96 b	208.33 a	195.15 A	173.67 efg	197.63 a-d	213.70 a	211.83 ab	199.20 A	171.82 efg	196.42 abc	210.33 a	210.08 a	197.18 A
15th May	145.60 n	163.71	184.27 g	201.93 c	173.87B	150.72 hi	167.8f gh	187.75 c-f	206.00 abc	178.00 B	148.13 h	165.68 fg	185.96cde	203.96 ab	175.94 B
1st June	143.30 o	170.6j	175.67 i	189.26 e	169.60B	148.33 hi	174.36 fg	178.66 d-g	192.67 a-e	173.51 B	145.80 1	172.48 h	176.96efg	190.96 def	171.56 B
15th June	128.43 p	156.9m	175.80 h	188.86 f	162.50 C	129.87 i	160.16 gh	178.33 d-g	191.00 b-e	164.84 C	129.15 bcd	158.53 i	177.06 gh	189.93 g	163.67C
Average	146.82 D	171.63C	185.57B	197.10 A		150.63 D	174.96 C	189.59 B	200.37 A		148.729D	173.29 C	187.58 B	198.74 A	
	2nd cut														
1st May	157.56 k	174.43 e	192.50 b	202.40 a	181.73 A	160.87 d	176.7 bcd	194.67 ab	204.83 a	184.16 A	159.22 e	175.35 cde	193.58 ab	203.62 a	182.94 A
15th May	127.00 n	160.13 i	161.80 h	187.03 c	158.99B	130.67 e	163.67cd	168.68 cd	189.00 abc	163.00 B	128.83 f	161.90 de	165.23 de	188.07 abc	160.99 B
1st June	125.06 g	156.93 l	162.26 g	176.30 d	155.14B	128.50 e	160.00 d	165.68 cd	179.00 bcd	158.29 B	126.78 f	158.47 e	163.96 de	177.65 bcd	156.72 B
15th June	80.53 p	133.63m	159.87 j	170.87 f	136.25 C	83.60 f	136.67 e	161.67 d	173.66 bcd	138.90 C	82.08 g	135.15 f	160.76 de	172.27 cde	137.56C
Average	122.54 D	156.28C	169.11B	184.15 A		125.91 D	159.15 C	172.67 B	186.63 A		124.25 D	157.72 C	170.89 B	185.38 A	
	3rdcut														
1st May	128.70 1	153.70 f	165.00 c	175.50 a	155.72 A	132.67 a	113.50 a	169.03 a	178.00 a	148.30 A	130.68 bc	133.60 bc	167.01 a	176.75 a	152.01 A
15th May	108.90 n	133.13 k	136.00 j	165.33 b	135.84B	112.33 a	138.00 a	139.33 a	168.33 a	139.50 B	110.61 d	135.56 bc	137.66 bc	166.83 a	137.67 B
1st June	108.73 n	138.50 i	142.66 g	163.63 d	138.38B	113.40 a	141.66 a	145.33 a	166.66 a	141.75 B	111.03 d	140.08 bc	144.00 b	165.15 a	140.07 B
15th June	68.33 o	120.00m	139.67 h	160.00 e	122.00 C	74.00 a	125.00 a	142.66 a	163.00 a	126.17 C	71.17 e	122.50 cd	141.16 b	161.50 a	124.08C
Average	103.66 D	136.33 C	145.83B	166.12 A		108.08 C	129.52 BC	149.09 AB	169.00 A		105.87 D	132.94 C	147.46 B	167.56 A	

1- Capital letters were statistically significant of average.
2- Small letters were statistically significant of interaction.

levels on plant height at the three cuts in both seasons as well as their combined was significant with except that the third cut in the second season that this interaction no significant. The highest values of plant height were attained in planting date at 1st May or 40 kg.N/ fad., while the lowest values in this respect was attained when sowing date at 15th June with without N fertilization.

2- ***Number of tillers/plant:***

The average of number of tillers per plant as affected by sowing dates, nitrogen fertilization levels and their interaction at the different cuts of each season and over the two seasons are given in Table (3). In general and over the four nitrogen fertilization levels, number of tillers per plant decreased consistently and significantly as sowing was delayed from 1st May to 15th June that was true in the different cuts in each season and over the two seasons. However, in the 1st cut the differences in number of tillers per plant between the 15th May and 1st June sowing dates were not significant in the combined. These results could be attributed to the more favorable prevailing conditions for the earlier sowing. This result are in the same trend with those obtained by **Al-Dulami and Al-Fahdoy (2011), Lauriault *et al*. (2012), Karhale *et al.* (2014), Rari *et al.* (2014) and Khrbeet and Jasim (2015).**

Over the four sowing dates studied in number of tillers were significant and to 40 kg N/fad. had always the greatest and highest no. of tillers followed by 0, 20 and 30 kg N/fad. This result could be noticed in all cuts of the first, second and combined. That is might be due to the importance of nitrogen fertilizer to increase the weight of vegetative organs by photosynthesis, where importance of nitrogen nutrient for synthesis of amino acids, nucleic acids and organic acids etc. which are necessary for number of tiller. The findings are in close conformity with **Shakil and Agrawal (2002).** The highest gross and net monetary returns and benefit castrations were also obtained at 40kg N/fad., reported by **Saini and Tiwana (2013),Abou-Amer (2014), Hussein and Sabbour (2014), Holman *et al.* (2019), Elango *et al.* (2020), Noori (2020), Mohammad *et al.* (2022), YÖNter *et al.* (2022) and Farhadi *et al.* (2023).** The interaction effect between the two studied factors on number of tillers per sorghum hybrid plant was not significant neither in each growing season nor in the averages of the two seasons and this held true at the third cuts took place.

3- Number of leaves per plant:-

Table (4) illustrates the average of number of leaves per plant as affected by date of sowing and nitrogen fertilization levels at rach cut in each seasons and over the two seasons. number of leaves per plant decreased consistently and significantly as planting was delayed from 1th may to 15th June in the 3rd cuts in the two seasons. Planting date of 1th may gave the highest number of leaves per plant in than third cut. While, there

Table (3): Effect of Sowing dates , Nitrogen fertilization rates and their interaction on (No. of Tillers/plant). in both seasons (2022 and 2023) and combined.

Items	Levels nitrogen (kg/fad)														
	2022season					2023 season					Combined				
	0	20	30	40	Average	0	20	30	40	Average	0	20	30	40	Average
								1stcut							
1st May	5.00 a	7.33 a	9.00 a	8.33 a	**7.41 A**	6.33 a	8.33 a	10.00 a	9.33 a	**8.50 A**	5.66 a	7.83 a	9.50 a	8.83 a	**7.96 A**
15th May	4.33 a	5.83 a	7.00 a	8.33 a	**6.37 AB**	5.33 a	6.80 a	7.33 a	8.33 a	**6.92 B**	4.83 a	6.25 a	7.17 a	8.33 a	**6.65 B**
1st June	3.00 a	4.66 a	6.76 a	8.66 a	**5.77 BC**	3.56 a	5.50 a	7.30 a	9.33 a	**6.42 BC**	3.28 a	5.08 a	7.03 a	9.00 a	**6.10 B**
15th June	2.46 a	4.40 a	5.33 a	7.33 a	**4.86 C**	2.93 a	5.00 a	5.86 a	7.60 a	**5.35 C**	2.70 a	4.67 a	5.60 a	7.47 a	**5.11 C**
Average	**3.70 D**	**5.54 C**	**7.02 B**	**8.16 A**		**4.54 C**	**6.38 B**	**7.65 A**	**8.65 A**		**4.12 D**	**5.96 C**	**7.35 B**	**8.41 A**	
								2nd cut							
1st May	3.53 a	5.83 a	6.33 a	6.50 a	**5.55 A**	3.93 a	6.33 a	6.63 a	7.67 a	**5.99 A**	3.73 a	6.08 a	6.43 a	6.78 a	**5.77 A**
15th May	3.17 a	4.50 a	4.66 a	6.50 a	**4.70 AB**	3.47 a	4.93 a	4.93 a	6.67 a	**5.05 A**	3.31 a	4.71 a	4.80 a	6.68 a	**4.88 B**
1st June	2.10 a	3.60 a	5.00 a	6.83 a	**4.38 AB**	2.03 a	3.17 a	4.50 a	6.67 a	**4.09 BC**	2.06 a	3.38 a	4.75 a	6.75 a	**4.24 C**
15th June	2.00 a	3.16 a	4.00 a	5.00 a	**3.57 C**	1.93 a	2.60 a	3.73 a	5.60 a	**3.47 C**	2.03 a	2.88 a	3.87 a	5.30 a	**3.52 D**
Average	**2.73 C**	**4.28 B**	**5.00 B**	**6.29 A**		**2.84 C**	**4.58 B**	**4.95 B**	**6.55 A**		**2.78 D**	**4.27 C**	**4.98 B**	**6.39 A**	
								3rdcut							
1st May	2.66 a	4.66 a	5.33 a	5.83 a	**4.63 A**	2.80 a	4.66 a	5.46 a	5.66 a	**4.65 A**	2.73 a	4.66 a	5.40 a	5.75 a	**4.64 A**
15th May	2.70 a	4.13 a	4.50 a	5.73 a	**4.26 A**	2.53 a	3.80 a	4.20 a	5.86 a	**4.10 B**	2.60 a	3.97a	4.35 a	5.80 a	**4.18 B**
1st June	1.46 a	2.46 a	4.13 a	4.93 a	**3.25 A**	1.50 a	2.50 a	4.20 a	4.86 a	**3.27 C**	1.48 a	2.48 a	4.16 a	4.90 a	**3.25 C**
15th June	1.50 a	2.20 a	3.00 a	3.66 a	**2.59 B**	1.36 a	2.03 a	2.83 a	4.00 a	**2.56 D**	1.43 a	2.11 a	2.91 a	3.83 a	**2.57 D**
Average	**2.07 D**	**3.37 C**	**4.24 B**	**5.04 A**		**2.05 D**	**3.25 C**	**4.18 B**	**5.10 A**		**2.06 D**	**3.31 C**	**4.21 B**	**5.07 A**	

1- Capital letters were statistically significant of average.
2- Small letters were statistically significant of interaction.

Table (4): Effect of Sowing dates , Nitrogen fertilization rates and their interaction on(No .of leaves/ plant). in both seasons (2022 and 2023) and combined.

Items	Levels nitrogen (kg/fad)														
	2022season					2023 season					Combined				
	0	20	30	40	Average	0	20	30	40	Average	0	20	30	40	Average
1stcut															
1st May	12.00 a	13.13 a	13.00 a	14.70 a	**13.21 A**	8.50 a	10.00 a	10.17a	10.50 a	**9.79 A**	10,81 ef	11.75 a	11.00 ab	12.40 a	**11.49 A**
15th May	11.00 a	11.00 a	11.80 a	12.17 a	**11.49 B**	7.70 a	8.60 a	8.67 a	9.00 a	**8.49 B**	7.60 fg	8.60 cde	9.33 bcd	9.50 bc	**8.75 B**
1st June	9.40 a	10.00 a	11.00 a	11.67 a	**10.51 C**	6.00 a	6.70 a	8.17 a	8.70 a	**7.39 C**	5.60 h	6.33 gh	8.30 def	8.50 cde	**7.18 C**
15th June	7.00 a	7.50 a	8.17 a	8.66 a	**7.83 D**	3.67 a	4.18 a	6.00 a	6.40 a	**5.06 D**	3.50 i	4.08 i	5.92 h	6.40 gh	**4.97 D**
Average	**9.85 D**	**10.41 C**	**10.99 B**	**11.80 A**		**6.46 D**	**7.37 C**	**8.25 B**	**8.65 A**		**6.87D**	**7.69 C**	**8.63 B**	**9.20 A**	
2nd cut															
1st May	7.75 a	8.40 a	9.92 a	12.08 a	**9.54 A**	6.25 c-f	7.17 cd	7.66cd	10.17 a	**7.81 A**	7.58 cd	7.21 cde	8.58 abc	11.12 a	**8.63 A**
15th May	6.00 a	7.09 a	9.25 a	11.17 a	**8.38 B**	5.83 def	7.58 acd	8.08ab	9.53 ab	**7.75 A**	6.04 efg	6.46 fg	8.09 bc	10.14 ab	**7.68 B**
1st June	5.00 a	7.09 a	8.50 a	10.83 a	**7.86 C**	5.20 def	6.80 cde	7.25 acd	7.16 cd	**6.61 B**	5.72 gh	5.83 efg	8.25 cde	9.17 bcd	**7.24 B**
15th June	4.58 a	5.83 a	7.25 a	9.58 a	**6.81 D**	3.70 g	5.92fg	6.58c-f	6.92 cde	**5.78 C**	5.75 h	5.75 h	7.02 def	8.25 efg	**6.69 C**
Average	**5.83 D**	**7.10 C**	**8.73 B**	**8.51 A**		**5.25 D**	**6.87 C**	**7.39 B**	**8.45 A**		**6.27 D**	**6.31 C**	**7.98 B**	**9.67 A**	
3rdcut															
1st May	7.75 e	8.33 d	9.92 c	12.08 a	**9.52 A**	3.67 fg	5.20 c	6.83 ab	8.08 a	**5.95 A**	5.29 e	6.00 d	7.75 c	9.12 a	**7.04 A**
15th May	6.00 f	7.08 e	9.25 c	11.16 ab	**8.37 B**	2.58 fg	4.78 d	6.84 ab	7.00 b	**5.30 A**	5.37 e	5.60 d	7.37 c	8.92 ab	**6.82 A**
1st June	5.00 g	7.08 e	8.50 d	10.83 bc	**6.81 C**	2.16 g	4.50 d	6.58 ab	6.16 ab	**4.85 B**	4.83 f	5.50 d	8.29 ab	8.70 ab	**6.83 A**
15th June	4.58 g	5.83 g	7.25 e	9.58 c	**6.81 D**	2.92 efg	2.84 f	5.92 c	6.70 ab	**4.59 B**	4.37 f	4.60 d	5.87 d	8.20 ab	**5.76 B**
Average	**5.83 D**	**7.08 C**	**8.73 B**	**10.91 A**		**2.83 D**	**4.33 C**	**6.54 B**	**6.98 A**		**4.96 D**	**5.61 C**	**7.32 B**	**8.74 A**	

1- Capital letters were statistically significant of average.
2- Small letters were statistically significant of interaction

were no significant between 1st and 2nd sowing dates in the first and third cuts of the combined. As aforementioned previously delay of sorghum sowing affected negatively plant height and number of tillers per plant which could interpret the decrease ot number of leaves per plant as sowing had been delayed . **Al-Dulami and Al-Fahdoy (2011), Lauriault *et al.* (2012), Karhale *et al.* (2014) and Khrbeet, Jasim (2015) Jung *et al.* (2019), Mahalle *et al.* (2022).**

The results presented in Table (4) show also, that the differences among nitrogen fertilization rates over the four sowing dates studied in number of leaves per plant were significant and to 40 kg N/fad. had always the greatest and highest number of leaves per plant followed by 0, 20 and 30 kg N/fad. The increase in growth, number of leaves per plant might be attributed to increase photosynthetic and meristematic activities of plant and improvement in the synthesis of protein and amino acids in the presence of adequate available N supply. The findings are in close conformity with Sharma and Agrawal (2002). The highest gross and net monetary eturns and benefit : costratios were also obtained at 40kg N/fad. , reported by **Saini and Tiwana (2013), Abou-Amer (2014), Karhal *et al.* (2014), Hussein and Sabbour (2014),Chaudhary *et al.* (2018),Ates and Tenikecier (2019), Holman *et al.* (2019), Elango *et al.* (2020), Noori (2020), Mohammad *et al.* (2022) ,YÖNter *et al.* (2022) and Nayak *et al.* (2023) .**

The interaction effect between sowing dates and nitrogen fertilization levels on number of leaves / plant at the three cuts in both seasons as well as their combined was significant with except that the first and second cuts in the first season that this interaction no significant .The highest values of number of leaves / plant were attained in planting date at 1st May or 40 kg.N / fad., While the lowest values in this respect was attained when sowing date at 15 th June with without N fertilization .

4- Fresh leaves / stem ratio :

The effect of sowing dates, nitrogen fertilization levels and their interaction on leave / stem ratio at the three cuts in both seasons and their average are given in Table (5). Leave / stem ratio decreased consistently and significantly as planting was delayed from 1th may to 15th June in the third cuts in the two seasons. Planting date of 1th may gave the highest leave / stem ratio in than third cut. While there were no significant between 1st June and 15th June sowing dates in the three cuts in the two seasons and combined. Irrespective of sowing dates, nitrogen fertilizer levels 40 kg./ fad. on one hand significantly surpassed that of 0, 20 and 30 kg N /fad.in fresh leaves / stem ratio and that was true at the three cuts in the two seasons and their combined. These results are in accordance with those obtained by **Yonter *et al.* (2022) and Nayak *et al.* (2023).**

The interaction effect between sowing dates and nitrogen fertilization

Table (5): Effect of Sowing dates , Nitrogen fertilization rates and their interaction on (fresh leaves/stem ratio) in both seasons (2022 and 2023) and combined.

Items	Levels nitrogen (kg/fad).														
	2022season					2023 season					Combined				
	0	20	30	40	Average	0	20	30	40	Average	0	20	30	40	Average
1stcut															
1st May	41.33 fg	46.36 cd	49.50 b	55.16 a	**48.08 A**	40.90 f	47.00 bc	49.33 b	55.35 a	**48.14 A**	41.13 de	46.68c	49.41b	55.25 a	**48.12 A**
15th May	34.39 j	41.20 fg	44.66 de	49.0b c	**42.31 B**	32.73hi	41.33 f	45.31 cde	49.31 b	**42.18 B**	33.50 6g	41.27de	45.0c	49.16 b	**42.25 B**
1st June	29.36 k	35.26 ij	42.15 efg	45.33 d	**38.02 C**	30.31i	36.00 gh	43.00 def	46.33 bcd	**38.91 C**	29.85 h	35.63fg	42.57d	45.83 c	**38.47 C**
15th June	35.66 ij	37.33 hi	39.46 gh	42.43 ef	**38.72 C**	35.3gh	36.33 g	40.33 f	42.00 ef	**38.49 C**	35.50 fg	36.83f	39.9 e	42.21 d	**38.60 C**
Average	**35.18 D**	**40.04 C**	**43.94 B**	**47.98 A**		**34.83 D**	**40.17 C**	**44.50 B**	**48.25 A**		**35.01 D**	**40.10 C**	**44.22 B**	**48.12 A**	
2nd cut															
1st May	38.36 de	44.26 ab	45.33 a	42.66 abc	**42.65 A**	38.60 abc	43.0 ab	45.0a	45.00a	**42.92 A**	38.51 bc	43.63 a	45.16a	43.83 a	**42.78 A**
15th May	31.33 g	38.36 de	43.00 abc	44.00 ab	**39.17 B**	35.00 bc	36.33 bc	41.66ab	45.00a	**39.50 B**	33.16 de	37.35 cd	42.33ab	44.50 a	**39.33 B**
1st June	23.86 h	32.76 g	39.26 cd	40.00 bcd	**33.97 C**	31.00 c	30.66 c	38.66abc	36.60 abc	**34.25 C**	27.43 f	31.71 ef	38.96bc	38.33 bc	**34.11 C**
15th June	30.66 g	33.56 fg	34.23 efg	37.33 def	**33.94 C**	32.00 c	33.00 c	35.16bc	36.83 abc	**34.25 C**	31.34 ef	33.28 de	34.7cde	37.08 cd	**34.09 C**
Average	**31.05 C**	**37.23 B**	**40.45 A**	**40.99 A**		**34.14 B**	**35.37 B**	**40.13 A**	**40.87 A**		**32.61 C**	**36.5 B**	**40.29 A**	**40.94 A**	
3rdcut															
1st May	34.6c	41.6ab	42.0ab	43.0a	40.31A	33.40 def	39.30 bc	40.00 abc	44.00 a	**39.17 A**	34.00 e	40.46 c	41.0bc	43.50 a	**39.74 A**
15th May	29.23fg	34.13c	39.73b	41.7ab	36.19B	30.30 fgh	34.67de	41.00 abc	42.67 ab	**37.15 B**	29.78 fg	34.40 e	40.36 c	42.18 b	**36.68 B**
1st June	21.3h	28.03g	33.43cde	35.7c	29.61C	22.30 i	29.16 gh	29.16 de	29.16 cd	**27.45 C**	21.81 i	28.60 ch	34.05e	36.40 d	**30.20 C**
15th June	29.0fg	31.0def	30.8efg	33.67cd	31.08C	37.00 h	28.00 h	27.67 e-h	30.66 d-g	**30.83 C**	28.50 h	29.33 gh	30.66f	33.43 e	**30.45 C**
Average	**28.55D**	**33.69C**	**36.46B**	**38.51A**		**30.75 A**	**32.79 C**	**34.4B**	**36.62A**		**28.52 D**	**33.20 C**	**36.52 B**	**38.84 A**	

1- Capital letters were statistically significant of average.

2- Small letters were statistically significant of interaction.

levels on leaves / stem ratio at the three cuts in both seasons as well as their combined was significant The highest values of leaves / stem ratio were attained in planting date at 1st May or 40 kg.N / fad., While the lowest values in this respect was attained when sowing date at 15 th June with without N-fertilization.

5 - Stem diameter (cm) :

The average of stem diameter (cm) in three cuts of each season and over the two seasons as affected by sowing dates and nitrogen fertilizers levels are given in Table (6). The stem diameter of the plant increased significantly at the planting date of May 1st, superior to the other dates under study. While there are no significant differences between planting dates during May 15th June,1st and June 15th. That was true in the different cuts in each season and over the two seasons except the different between the 3rd cut in the combined were slight and significant. These results are in accordance with those given by **Rari *et al.* (2014), Noorbakhehian (2016), Jung *et al.* (2019),Mahalle *et al.* (2022).**

Over the four sowing dates, the nitrogen fertilizer levels 40 kg/ fad on one hand significantly surpassed that of 0, 20 and 30 kg N /fad. that was true at the three cuts in the two seasons and their combined. Nitrogen play a most important role in various physiological processes. It imparts dark- green color in plant , promotes leaves, stem and other vegetative part's growth and development. These results are in accordance with those obtained by **Afzal *et al.*(2013), Abou-Amer(2014), Mekdad and El-sherif (2016), Chauhary *et al.*(2018), Ates and Tenikecier (2019).**

The interactions effect between sowing dates and nitrogen fertilization levels on stem diameter (cm) / plant at the three cuts in both seasons as well as their combined were significant, except ,the 1st and 2nd cuts in the first season was no significantly. The highest values of stem diameter were attained in planting date at 1st May or 40 kg.N / fad.. While the lowest values in this respect was attained when sowing date at 15 th June with without N fertilization.

6 . Total fresh forage yield (ton / fad.):

The average of total fresh forage yield (ton/fad.) of different cuts as influenced by sowing dates, nitrogen fertilization levels and their interaction in each season and over the two seasons are presented in Table (7) . It was noted that, the total fresh forage yield (9 ton/ fad.) decreased consistently and significantly as planting was delayed from 1th May to 15th June in the 3rd cuts in the two seasons and combined. Moreover, data in table (7) shows that comparing to swing in 1st may, over the two seasons, the total fresh forage yield (ton/fad.) decreased in the season by 0.55, 6.05 and 9.04 tons/fad., in the

second season by 16.92, 21.31 and 27.45 tons/ fad.and 4.72, 6.15 and 12.15ton/

Table (6): Effect of Sowing dates , Nitrogen fertilization rates and their interaction on(Stem Diameter (cm) in both seasons (2022 and 2023) and combined.

	Levels nitrogen (kg/fad).														
	2022season					2023 season					Combined				
	0	20	30	40	Average	0	20	30	40	Average	0	20	30	40	Average
	1stcut														
1st May	1.17 gh	1.30 ef	1.60 a	1.83 b	**1.475 A**	1.33 de	1.43 cd	1.76 b	1.93 a	**1.617 A**	1.250 de	1.367 cd	1.68 b	1.883 a	**1.546 A**
15th May	0.721	1.03 ij	1.167 gh	1.43 cd	**1.088 B**	0.90 i	1.17 fg	1.30 e	1.53 c	**1.225 B**	0.810 h	1.10 fg	1.23 def	1.483 c	**1.157 B**
1st June	0.671	0.93 jk	1.06 hi	1.36 de	**1.010 B**	0.80 ij	1.07 gh	1.23 ef	1.46 c	**1.142 B**	0.737 h	1.00 g	1.15 ef	1.417 c	**1.076 B**
15th June	0.631	0.90 k	1.20 fg	1.53 bc	**1.067 B**	0.73 j	1.030 h	1.30 e	1.70 b	**1.192 B**	0.683 h	0.967 g	1.25 de	1.617 b	**1.129 B**
Average	**0.798 D**	**1.042 C**	**1.258 B**	**1.54 A**		**0.942 D**	**1.18 C**	**1.40 B**	**1.66 A**		**0.870 D**	**1.108 C**	**1.329 B**	**1.60 A**	
	2nd cut														
1st May	1.00 a	1.17 a	1.33 a	1.67 a	**1.242 A**	1.10 fg	1.33cde	1.48 abc	1.63 a	**1.380 A**	1.050 f	1.25 de	1.40 bc	1.55 a	**1.312 A**
15th May	0.63 a	1.00 a	1.03 a	1.67 a	**1.008 B**	0.83 hi	1.43 fg	1.20 ef	1.56 ab	**1.30 AB**	0.733 hi	1.05 f	1.130 ef	1.46 ab	**1.092 B**
1st June	0.60 a	0.80 a	0.97 a	1.20 a	**0.892 B**	0.80 hi	0.967gh	1.10 fg	1.40 b-e	**1.067 B**	0.700 hi	0.883 g	1.033 f	1.30 cd	**0.979 B**
15th June	0.54 a	0.73 a	1.03 a	1.30 a	**0.902 B**	0.73 i	0.93ghi	1.23 def	1.43 a-d	**1.083 B**	0.637 i	0.83g h	1.133 ef	1.37 bcd	**0.993 B**
Average	**0.69 D**	**0.25 C**	**1.09 B**	**1.33 A**		**0.867D**	**1.083C**	**1.25 B**	**1.508 A**		**0.78 D**	**1.004 C**	**1.171 B**	**1.421 A**	
	3rdcut														
1st May	0.887a	1.00 a	1.13 a	1.23 a	**1.063 A**	1.00 cde	1.13bcd	1.30 ab	1.43 a	**1.217 A**	0.943 fg	1.067 def	1.217 bc	1.33 ab	**1.140 A**
15th May	0.53 a	0.80 a	0.97 a	1.30 a	**0.90 B**	0.70 gh	0.93def	1.10 bcd	1.43 a	**1.042 B**	0.617 jk	0.867 gh	1.033 def	1.37 a	**0.971 B**
1st June	0.50 a	0.70 a	0.90 a	1.03 a	**0.783 BC**	0.75 fgh	0.867efg	1.067cde	1.167 bc	**0.958 B**	0.617 jk	0.783 hi	0.983 efg	1.10 cde	**0.871 C**
15th June	0.40 a	0.60 a	0.90 a	1.10 a	**0.75 C**	0.60 h	0.767fgh	1.00 cde	1.20 bc	**0.892 B**	0.50 k	0.683 ij	0.950 fg	1.15 cd	**0.821 D**
Average	**0.58 D**	**0.775 C**	**0.975 B**	**1.167 A**		**0.75 D**	**0.925C**	**1.117 B**	**1.308 A**		**0.669 D**	**0.850 C**	**1.046 B**	**1.238 A**	

1- Capital letters were statistically significant of average.
2- Small letters were statistically significant of interaction.

Table (7): Effect of cutting systems, nitrogen fertilization rates and their interaction on total fresh forge yield (ton/fad). Data are combined over too growing seasons 2022 and 2023.

Sowing date	Levels nitrogen (kg/fad).				
	zero	20	30	40	Average
2022 season					
D1	34.35 a	42.58 a	46.46 a	53.37 a	**44.14 A**
D2	30.27 a	43.06 a	47.84 a	52.29a	**43.59 B**
D3	28.19 a	37.65 a	40.19 a	44.26 a	**38.09 C**
D4	28.85 a	31.19 a	39.59 a	41.80 a	**35.10 D**
Average	**30.30 D**	**38.61 C**	**43.52 B**	**48.66 A**	
2023 season					
D1	45.50 cd	55.00 b	70.30 a	76.00 a	**61.71 A**
D2	31.10 fg	43.40 de	48.67 bc	55.00 b	**44.79 B**
D3	28.10 g	40.16 c-f	43.00 cde	47.33 bcd	**40.40 C**
D4	27.73 g	35.36 efg	35.66 efg	38.27 efg	**34.26 D**
Average	**33.12 D**	**43.48 C|**	**49.42 B**	**54.15 A**	
Combined of the seasons					
D1	36.60 gh	43.10 def	54.97 ab	58.99 a	**48.41 A**
D2	32.61 hi	43.23 def	48.25 cd	55.13 ab	**43.69 B**
D3	28.14 i	41.37 efg	44.73 de	50.32 bc	**42.26 B**
D4	28.97 i	36.51 gh	37.93 fgh	41.26 efg	**36.16 C**
Average	**31.59 D**	**41.05 C**	**46.47 B**	**51.40 A**	

1- Capital letters were statistically significant of average.
2- Small letters were statistically significant of interaction.

fad. in the combined, *i.e* the total yield decreased in the first season by 1.24% , 13.71% and 20.48%, in the second season by 27.42%, 34.53% and 44.48% and in the combined by 9.75% , 12.70% and 25.30% with delay sowing to 15th May, 1st June and 15th June respectively. Here, as mentioned before, the more favorable prevailing contestations during may planting resulted in a high germination percentage and more vigorous seedling hence, a good planting density, establishment and growth were obtained by **Al-Dulami and Al-Fahdoy (2011), Rafiee (2018), Khatana *et al* (2020) and Shakil *et al* (2023).**

The results presented in Table (7) show also, that the differences among nitrogen fertilization rates over the four sowing dates studied in total fresh forage yield (ton/fad.), were significant and to 40 kg N/fad; had always the greatest and highest fresh forage yield /cut (fad.). Followed by 0, 20 and 30 kg N/fad. These were true in the first, second and combined. The increase in

growth, fresh forage yields might be attributed to increase photosynthetic and meristematic activities of plant and improvement in the synthesis of protein and amino acids in the presence of adequate available N supply. The highest gross and net monetary eturns and benefit: cost ratios were also obtained at 40kg N/fad., reported by **Joorabi *et al*. (2015), Ahmidi *et al* (2016), Norri (2020) , Mohammad *et al* (2022).** The interaction effect between the two studied factor on total fresh forage yield (ton/ fad.) of sorghum hybrid was not significant in the first season . While at the second as well as their combined was significant. The highest values of total fresh forage yield (ton/ fad.) were attained in planting date at 1st May or 40 kg.N / fad. (76 ton / fad in the second season), while the lowest values (27.73 ton /fad.in the second season) in this respect was attained when sowing date at 15 th June with without N fertilization.

Recommendation :

The results of this study recommended by the planting sorghum hybrid in 1th May and fertilizing with 40 kg N / fad. under condition of Kafr El- Sheikh Governorate , Egypt.

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تأثير مواعيد الزراعة ومستويات التسميد النيترجينى على النموومحصول العلف الأخضر فى هجين السورجم

صبحى حميده محمد ابراهيم ابورية [١]، السيد بيومى جاب الله [١] ، مها محمد عبد الله [١] ، منى محمد غازى [٢]

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اقيمت تجرتين حقليتين فى مزرعة مركز البحوث الزراعية بسخا محافظة كفر الشيخ – مصر ، تحت اشراف قسم الانتاج النباتى بكلية التكنولوجيا والتنمية جامعة الزقازيق خلال موسمى ٢٠٢٢ و ٢٠٢٣ بهدف دراسة تأثير أربعة مواعيد لزراعة هجين السورجم (سخا- ١) وكانت مواعيد الزراعة كالتالي: (١ مايو، ١٥ مايو ، ١ يونيو و ١٥ يونيو) والتسميد النيترجينى للفدان بأربعة مستويات (بدون اضافة ، ٢٠ كجم/ ن ، ٣٠ كجم /ن و ٤٠ كجم/ ن).

* صممت التجربة بنظام القطاعات المنشقة مرة واحدة فى ثلاث مكررات .
* وكانت الصفات تحت الدراسة هى : ارتفاع النبات (سم) ، عددالفروع\ نبات ، عدد الاوراق \ نبات ، نسبة الاوراق الطازجة الى الساق ، قطر الساق (سم) والمحصول الكلى للعلف الطازج (طن \ فدان).
* أظهرت النتائج أن ميعاد الزراعة الاول فى ١ مايو تفوق معنويا فى كل من : ارتفاع النبات (سم) ، عددالفروع\ نبات ، عدد الاوراق \ نبات ، نسبة الاوراق الطازجة الى الساق ، قطر الساق (سم) والمحصول الكلى للعلف الطازج (طن \ فدان).
* التسميد النيتروجينى بمعدل ٤٠ كجم / فدان سجل زيادة معنوية متفوقا على المعدلات الاخرى (بدون اضافة ، ٢٠ و ٣٠ كجم نيتروجين \ فدان) وكان ذلك حقيقيا خلال موسمى الزراعة ومتوسطهما .

التوصية : _توصى الدراسة بزراعة هجين السورجم فى الميعاد الاول (١ مايو) مع التسميد بالسماد النيتروجينى بمعدل ٤٠ كجم\ فدان تحت ظروف محافظة كفر الشيخ – مصر.