University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

Response of Sudangrass (*Sorghum vulgare var. sudanense* L.) crop to planting dates and NPK fertilizer levels

Doaa Salman Marzouq, Lamiaa Mahmood Salman

Crops Department, Faculty of Agriculture, Basrah University, Iraq.

E-mail:- pgs.doaa.salman@uobasrah.edu.iq

E-mail:- lamiaa.Salman@uobasrah.edu.iq

Abstract

A field experiment was conducted at the Agricultural Research Station - Karma Ali site - College of Agriculture - University of Basra / during the summer agricultural season 2024. With the aim of knowing the best planting date in the southern region and determining the best fertilizer level of the compound fertilizer NPK (equivalent 20:20:20) for the Sudan grass crop. The experiment was conducted in a split-plot design using a randomized complete block design (R.C.B.D) with three replicates. The main plots contained NPK levels (0, 200, 400 and 600 kg ha-1) and were symbolized by the symbols F0, F1, F2 and F3 respectively, while the sub-plots occupied three planting dates: March 1, March 15 and April 1. Fertilizer was added after 20 days of planting in the form of NPK and nitrogen fertilizer batches were completed after each mowing in the form of urea fertilizer (46%N). Three mowings were taken during the crop growth period. Plant height, number of branches, number of leaves, stem diameter, specific leaf weight, chlorophyll percentage, green and dry forage yield were measured for all three mowings. The results showed that the difference in fertilization levels had a significant effect on most of the studied traits, F2 level recorded the highest green fodder yield, reaching 24.740 µg ha^{-1}, without a significant difference from the F3 level (24.370 megagrams ha-1) for the first harvest, while the F3 level was superior and gave the highest average green fodder yield, reaching 44.880 and 20.230 µg ha^{-1} for the second and third harvests, respectively. The dates had a significant effect on most of the studied traits. The second date recorded the best green fodder yield of 26.720 µg ha^{-1} 33 in the first cut, while the first date D1 gave the highest average for the trait for the second and third cuts, reaching 32.160 and 12.840 µg ha^{-1}. The second date recorded the highest average for dry fodder yield of 8.900 µg ha^{-1} for the first cut, and the first date outperformed, recording the highest average of 10.970 and 4.650 µg ha^{-1}, respectively, for the second and third cuts of dry fodder yield.

Key words: Sudan grass, NPK fertilizer, planting date.

I. INTRODUCTION

Sudan grass (*Sorghum vulgare var. sudanense* L.) is a forage sorghum species, and has a similar plant composition to it, but it has more shoots and stems compared to forage sorghum (Casler, 2003). In addition, it has a high ability to grow quickly after mowing, which makes it more suitable for grazing and hay production (Mohammed, 2010). Hybrids are usually the result of crosses between female forage sorghum and male Sudangrass. These hybrids show higher biological productivity than Sudangrass due to their ability to produce a larger number of branch. They also have faster growth compared to forage sorghum, but less than Sudangrass (Venuto, 2008). Sudan grass is native to East Africa and grows in subtropical and tropical regions, and is also cultivated in South Asia, South America and Southern Europe. It is preferred over other summer forage crops because it is palatable, nutritious and less toxic with persic acid (HCN). In addition, it produces large quantities of fodder compared to other sorghum fodders. The crop is also used as green fodder or silage, and because the crop is a C4 plant with high efficiency in utilizing solar energy, which made the crop have a high production of dry matter and give a high green and dry fodder yield (Barsila, 2018). The amount of fodder produced from it and the date of its availability depend

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

mainly on the planting date, in addition to the availability of irrigation, fertilization and weather conditions, as it is possible to obtain 20 µg ha^{-1} of dry fodder, or 60 µg ha^{-1} of silage, or 100 µg ha^{-1}of green fodder during the summer season. Since this crop is being planted for the first time in the region, determining the appropriate planting date for it is one of the main factors affecting the yield of green and dry fodder and its quality, due to the effect of the planting date on plant growth due to the variation of climatic conditions such as temperature and photoperiod from one date to another. The changes that occur to climatic conditions that coincide with the difference in planting date may affect most of the vital activities that take place in the plant (Atiya and Wahib, 1989). The planting date affects plant growth due to changes in climatic conditions such as temperature and photoperiod from one date to another. Climatic differences associated with planting time may significantly affect many vital processes occurring in the soil and plant. NPK fertilizer is considered one of the most important fertilizers that provide the plant with the major nutrients necessary for its growth, as it plays a major role in feeding the plant by providing the major essential elements it needs. Accordingly, this study was conducted, which aims to find out the best planting date in the southern region and determine the best fertilizer level of NPK compound fertilizer, and determine the best interaction between dates and fertilizer levels that determines the best green and dry fodder yield in terms of quantity and quality.

I. Material and methods:

A field experiment was conducted at the Agricultural Research Station/College of Agriculture - University of Basra/Karmat Ali site during the summer agricultural season of 2024. The experiment included studying two factors: 1- Three planting dates: March 1, March 15, and April 1, 2- 4 levels of balanced NPK compound fertilizer 20:20:20, (0, 200, 400, and 600 kg NPK ha-1) and symbolized by the symbol 0 F, F1, F2, and F3, added 20 days after planting in the form of balanced NPK fertilizer, and nitrogen fertilizer batches are completed after each harvest in the form of urea fertilizer (46%N). The experiment was carried out using a split-plot design using a randomized complete block design (R.C.B.D) with three replicates. The main plots contained NPK levels, while the sub-plots occupied the planting dates. The number of experimental units was 36 (4×3×3) experimental units. The land was divided according to the design used into experimental units with dimensions of 2m×3m (6m2). Each experimental unit contained six lines, the distance between each line was 50 cm and between each hole was 20 cm (Abdullah et al. 2021). Sudan grass seeds (HAMAX variety) were planted manually according to the dates under study, by placing 3 seeds in the hole, and the thinning process was carried out to one plant two weeks after planting for all experimental panels before adding compound fertilizer to the experiment. The field was irrigated immediately after planting, while other irrigations were given as needed. The field was weeded to remove the growing weeds as needed. Three mowings were taken from the crop, the first mowing was 70 days after planting, the second was 45 days after the first mowing date, and the third was 45 days after the second mowing date. The mowing was done at a height of 6-9 cm above the ground surface.

Table (1) Some physical and chemical properties of field soil and irrigation water before planting

adjective	Ph	soil	water	O.M	N	P	K	clay	silt	sand
unite		E. C. (dc/m)	E. C. (dc/m)	gm kg^{-1}	Available (mg/kg)			gm Kg^{-1}		
Value	7.38	8.64	3.22	1.96	32.01	10.99	90.52	360	510	130

University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 https://doi.org/10.54174/utjagr.v13i1.323

From the average of ten plants randomly selected from each experimental unit, the following traits were measured:

1-Plant height (cm)

2-Number of shoots (plant shoot-1)

3-Number of leaves (plant leaf-1)

4-Specific weight of the leaf (g cm-2) SWL : it was calculated according to the following equation: Specific weight of the leaf = dry weight of the leaf (g) / leaf area (cm)

5-Stem diameter (mm).

6 -Chlorophyll (mg L-1) = [20.2 D (645) 8.02 D (663)] ×V/1000 ×W. (Goodwin 1976)

D: Optical density reading of extracted chlorophyll based on wavelengths 663 nm 645 nm respectively

V: Final volume of diluted acetone at a concentration of(%80)

W: Weight of fresh sample (0.5 g)

7- Green fodder yield per cutting (µg ha^{-1})

8 - Dry feed yield per cutting (µg ha^{-1})

II. Results and discussion:

1-Plant height (cm): The results of Table 2 indicated that the F1 level was superior in the first cut and gave the highest average plant height of 59.09 cm. As for the second and third cuts, the F3 level gave the highest average plant height of 96.66 and 39.34 cm, respectively. The comparison treatment recorded the lowest average for the trait of 49.12 and 17.67 cm, respectively, for the first and third cuts. Both F0 and F2 recorded the lowest average plant height of 54.65 and 55.84 cm, respectively, for the second cut, without a significant difference between them. This can be attributed to the role of nitrogen in increasing plant growth and activity by increasing the activity of meristematic cells, as well as its entry into the composition of tryptophan acid, which is responsible for building auxin, which is considered the primary contributor to increasing the division of apical cells and their elongation, in addition to the role of phosphorus in increasing the height of the plant through its cycle in the formation of energy-rich compounds (ATP), which work as co-factors for enzymes in the plant. It also works to strengthen the roots of the plant and increase its branches, which helps in absorbing nutrients from the soil solution, which is reflected in increasing the height of the plant (Al-Tamimi 2005). This is consistent with what Kareem and others (2021) reached. Potassium also has an important role in increasing the process of photosynthesis and activating the division of meristematic cells and the occurrence of elongation through ideal expansion in the cell wall, which is necessary for the division process (Raza et al., 2021).

The second date outperformed the first and third harvests by giving the highest average for the plant height compared to the first and third harvests, reaching 69.08 and 32.56 cm, respectively. As for the second harvest, the first date gave the highest average for the trait, reaching 70.90 cm. The reason for the height of the Sudan grass plant at the second planting date may be due to the fact that the climatic conditions were suitable for seed germination,

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

cell division and elongation, and consequently the accumulation of photosynthesis products. This is consistent with what was reached by (Khrbeet et al. 2015).

The results of the table showed that the F1 level with the second date gave the highest average plant height of 84.53 cm for the first cut, while in the second cut, the F2 and F3 levels at the first date gave the highest plant height of 74.86 and 74.75 cm, respectively, while the F3 level at the second date recorded the highest average plant height of 55.06 cm for the third cut. The combination F2 × D1 recorded the lowest plant height (34.40 cm) at the first cut, while in the second and third cuts, the combination F0 × D3 gave the lowest average plant height of 38.17 and 10.80 cm for the two cuts, respectively.

Table (2) Effect of planting dates and NPK fertilizer levels on plant height (cm) of Sudan grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
	First cut				
D1	40.20	35.47	34.40	42.93	38.25
D2	62.87	84.53	66.13	62.77	69.08
D3	44.30	57.27	53.90	53.67	52.28
LSD	9.083				5.105
	49.12	59.09	51.48	53.12	
LSD	4.671				
	Secund cut				
D1	73.44	60.56	74.86	74.75	70.90
D2	55.90	69.54	56.97	72.46	63.72
D3	38.17	43.13	32.11	53.67	41.77
LSD	5.047				2.048
	55.84	57.74	54.65	96. 66	
LSD	4.345				
	Third cut				
D1	20.66	33.06	28.74	34.25	29.18
D2	21.55	25.88	27.75	55.06	32.56
D3	10.80	17.67	25.46	28.70	20.66
LSD	3.259				1.954
	17.67	25.54	27.32	39.34	
LSD	0.905				

2-Number of branches (branch plant^{-1}): The F2 fertilizer level was superior and achieved the highest number of branches, reaching 14.44 branch plant -1 for the first cut, while the F3 level gave the highest number of branches, reaching 23.88 and 21.49 branch plant -1 for the second and third cuts, respectively. While the F1 fertilization treatment achieved the lowest average, reaching 8.17 branch plant -1 for the first cut, the comparison treatment achieved the lowest average, reaching 17.42 and 14.58 branch plant -1 for the second and third cuts, respectively (table 3). The reason for the increase in the number of branches with increasing levels of fertilization may be due to its effect in stimulating lateral buds and then encouraging the growth of buds and increasing branch. It was also noted that the number of branches increased with the increase in the number of mowings due to mowing operations and the aging of the plant as a result of the formation of secondary branch from the buds present in the axils of the basal leaves of the primary branch (Al-Azirjawi 2020). This result was consistent with what Somashekar (2019) and Al-Aboudi and Al-Abdullah (2022) reached when increasing levels of nitrogen fertilizer led to an increase in the number of branches of the Sudan grass plant.

The second date achieved the highest number of branches, reaching 15.55 and 20.93 branch-1, respectively, for the first and second harvests, without a significant difference from the first date (20.27 branch-1), while the first date

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

achieved the highest number of branches, reaching 22.27 branch-1 for the second harvest. As for the first date, it recorded the lowest number of branches for the first harvest, reaching 7.04 branch-1, while the third date gave the lowest number of branches, reaching 18.65 and 9.58 branch-1, respectively, for the second and third harvests. The reason for the increase in the number of branches may be due to the suitability of environmental conditions such as temperature and humidity. This results agreement with Abdullah (2021).

The F2 level with the third date recorded the highest number of branches, which amounted to 24.63 branch plant -1 for the first cut, while the F3 level with the second planting date gave the highest number of branches, which amounted to 25.60 and 28.60 branch plant -1, respectively, for the second and third cuts. The combination D1 × F1 recorded the lowest mean for the trait, which amounted to 5.97 branch plant -1 for the first cut, while the combination F0 × D2 recorded the lowest number of branches, which amounted to 15.43 branch plant -1 for the second cut, while the combination D3 × F1 recorded the lowest number of branches, which amounted to 8.37 branch plant -1.

Table (3) The effect of planting dates, NPK fertilizer levels and their interaction on the number of branches (plant branch-1) of Sudanese grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	treatments
	First cut				
D1	7.20	5.97	7.73	7.25	7.04
D2	10.73	10.64	24.63	16.17	15.55
D3	8.09	7.89	10.97	11.85	9.70
LSD	1.423				0.580
	8.68	8.17	14.44	11.76	
LSD	1.223				
	Secund cut				
D1	19.28	20.19	24.88	24.74	22.27
D2	15.43	20.02	17.06	25.16	19.42
D3	17.54	19.06	16.24	21.75	18.65
LSD	2.473				1.058
	17.42	19.76	19.39	23.88	
LSD	2.059				
	Third cut				
D1	10.47	19.89	24.12	26.59	20.27
D2	23.10	20.80	11.20	28.60	20.93
D3	10.18	8.37	10.47	9.29	9.58
LSD	2.989				1.548
	14.58	16.35	15.26	21.49	
LSD	1.978				

3-Number of leaves (leaf plant^{-1}): The results of Table 4 showed that the F1 level was superior in the first harvest by giving the highest number of leaves, which amounted to 62.32 leaves per plant-1, and in the second harvest, the F3 level was superior and gave the highest average, which amounted to 153.1 leaves per plant-1, while the comparison treatment gave the lowest number of leaves, which amounted to 53.85 and 97.8 leaves per plant-1, respectively, for the first and second harvests. The reason for the increase in the number of leaves per plant may be due to the increase in fertilization levels, due to the effective role of nitrogen in encouraging the plant to grow vegetatively, which increases the activity of cell division and expansion, which works to elongate the internodes of the nodes growing under the soil surface and thus appear above the soil surface, which leads to an increase in the number of nodes and ultimately an increase in the number of leaves because each stem node produces a leaf. These

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

results are consistent with what Jassim and Mona (2015), Awad Allah and Morsi (2016), and also Al-Jubouri and Omar (2018), Afolabi and others (2020) reached.

The second date was superior and gave the highest average number of leaves, reaching 78.64 leaves per plant-1 for the first harvest, while the first date was superior in the second and third harvests and gave the highest average number of leaves, reaching 162.2 and 92.3 leaves per plant-1, respectively, while the third date gave the lowest number of leaves, reaching 39.45, 109.4 and 23.3 leaves per plant-1, respectively, for the three harvests. The reason for the increase in the number of leaves at these dates may be due to the availability of optimal growth factors, which contributed to increasing both plant height (Table 2) and the number of branches (Table 3), which are positively correlated with the number of leaves.

The results of the table indicated that the F1 level with the second date gave the highest number of leaves, which amounted to 106.48 leaves per plant-1 for the first harvest, while the F3 level with the first date gave the highest number of leaves, which amounted to 202.4 and 114.0 leaves per plant-1 for the second and third harvests, while the interaction between the comparison treatment and the third planting date gave the lowest number of leaves, which amounted to 31.71 and 82.6 leaves per plant-1, respectively, for the first and second harvests, while the F1 level with the third date gave the lowest number of leaves, which amounted to 19.4 leaves per plant-1 for the third harvest.

Table (4) The effect of planting dates, NPK fertilizer levels and their interaction on the number of leaves per plant for Sudan grass crop.

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
	First cut				
D1	60.44	44.67	47.00	33.86	46.49
D2	69.41	106.48	67.73	70.95	78.64
D3	31.71	53.82	46.86	43.42	39.45
LSD	7.103				4.034
	53.85	62.32	53.86	49.41	
LSD	3.462				
	Secund cut				
D1	100.7	148.2	197.4	202.4	162.2
D2	110.0	125.7	125.9	110.0	125.7
D3	82.6	106.8	101.5	146.8	109.4
LSD	14.22				
	97.8	137.2	141.6	153.1	6.99
LSD	10.31				
	Third cut				
D1	63.6	96.6	95.0	114.0	92.3
D2	62.0	61.9	36.8	22.1	45.7
D3	29.2	19.4	21.5	23.0	23.3
LSD	16.16				8.01
	51.6	59.3	51.1	53.0	
LSD	NS				

4-Specific weight of the leaf (g cm-2) SWL: The results of Table 5 indicated that the F3 level was superior and gave the highest mean for the trait, reaching 19.67 mg cm-2 for the second harvest, without a significant difference from the F2 level (19.56 mg cm-2), while the F1 level gave the highest mean, reaching 37.00 mg cm-2 for the third

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

harvest, while the comparison treatment recorded the lowest specific weight at the second harvest, reaching 15.67 mg cm-2, while in the third harvest, the F2 level recorded the lowest specific weight, reaching 25.67 mg cm-2. The reason for the increase in the specific weight of the leaf may be attributed to the availability of nutrients in appropriate quantities, which contributed directly to increasing its ability to photosynthesize and thus store nutrients effectively, which enhanced leaf growth and increased its density and thickness.

The first date was superior, recording the highest Specific weight of the leaf of 19.42 mg cm-2 for the first cut, while the second date gave the highest average of 21.92 mg cm-2 for the second cut. The third date gave the highest average for the trait of 37.00 mg cm-2 for the third cut, while the third date gave the lowest Specific weight of the leaf of 14.00 and 28.67 mg cm-2 for the first and third cuts, respectively. The first date recorded the lowest Specific weight of the leaf of 14.33 mg cm-2 for the second cut.

The results of Table 5 showed that level F2 with the first date D1 gave the highest specific weight of 23.00 for the first cut, while level F2 with the second date D2 gave the highest specific weight of 26.67 for the second cut, while level F0 with the first date D1 gave the highest specific weight of 61.00 for the third cut.

Table (5) Effect of planting dates, NPK fertilizer levels and their interaction on the Specific weight of the leaf (mg cm-2) of Sudanese grass crop

treatments / Planting date	NPK levels F0	F1	F2	F3	
	First cut				
D1	13.33	22.00	23.00	19.33	19.42
D2	19.67	13.33	13.33	20.67	16.75
D3	18.00	12.00	14.00	12.00	14.00
LSD	3.119				1.688
	17.00	15.58	16.78	17.33	
LSD	NS				
	second cut				
D1	14.33	15.33	20.33	16.00	14.33
D2	17.33	21.33	26.67	22.33	21.92
D3	15.33	14.00	11.67	20.67	17.58
LSD	3.118				1.734
	15.67	16.89	19.56	19.67	
LSD	1.680				
	Third cut				
D1	24.00	36.00	23.33	31.33	28.67
D2	13.00	46.67	32.33	31.33	30.83
D3	61.00	28.33	21.67	37.00	37.00
LSD	6.027				3.390
	32.67	37.00	25.78	33.22	
LSD	3.086				

5-Stem diameter (mm): The results of Table 6 showed that the F2 fertilizer level achieved the highest average for the stem diameter trait at the second mowing, reaching 15.20 mm, without a significant difference from the F3 level (14.62 mm), while the F3 fertilizer level achieved the highest average for the trait at the third mowing, about 12.19 mm, while the comparison treatment achieved the lowest average for stem diameter, reaching 12.90 and 7.61 mm, respectively, at the second and third mowings. The reason may be due to the increase in both the leaf area trait, which leads to an increase in the photosynthesis process and thus an increase in the dry matter produced, which in turn enhanced the growth and increase in the stem diameter, in addition to the role of the phosphorus element and the increase in its availability and absorption by the plant roots and the role played by this element in encouraging

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

plant growth by increasing both the photosynthesis process and the manufacture of nutrients, thus increasing the size of the cells and the speed of their division. All of this led to an increase in the leaf area and thus an increase in the diameter of the plant stem. The result is consistent with Al-Janabi (2018) and Al-Taher and Atallah (2019), who obtained an increase Significant effect on stem diameter of white corn plant when nitrogen fertilizer was added, and also in agreement with Bukvic et al. (2003) who explained that increasing levels of phosphorus fertilizer led to an increase in stem diameter of the plant.

The results of Table 6 indicated that the second agricultural date achieved the highest average stem diameter trait, reaching 14.49 mm at the first harvest only, while the first date gave the lowest average stem diameter, reaching 10.06 mm. The reason for this can be attributed to the availability of suitable environmental conditions for plant growth, which increased the accumulation of dry matter, represented by the increase in stem diameter.

The second date D2 was superior at all studied fertilizer levels, recording the largest diameter of Sudanese grass stem, reaching 14.02, 14.09, 14.48 and 15.35 mm for levels F0, F1, F2 and F3, respectively, in the first harvest.

Table (6) Effect of planting dates, NPK fertilizer levels and their interaction on stem diameter (mm) of Sudanese grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
		First cut			
D1	7.88	10.83	11.43	10.09	10.06
D2	14.02	14.09	14.48	15.35	14.49
D3	14.68	11.68	10.59	14.06	12.75
LSD		2.824			1.334
	12.19	12.20	12.16	13.17	
LSD		NS			
		second cut			
D1	12.78	14.09	15.77	13.59	14.23
D2	12.74	13.57	14.52	15.54	14.09
D3	13.19	15.79	15.32	14.74	14.76
LSD		NS			NS
	12.90	14.71	15.20	14.62	
LSD		1.654			
		Third cut			
D1	8.26	10.01	9.20	11.52	9.75
D2	7.08	8.57	10.22	12.99	9.71
D3	7.50	8.82	11.37	12.06	9.94
LSD		NS			NS
	7.61	9.13	10.27	12.19	
LSD		0.948			

<u>6 -Chlorophyll (mg L-1):</u> The results of Table 7 indicated that the F3 level recorded the highest average chlorophyll percentage for the first and second harvests, reaching 0.3433 and 0.3744 mg 100 g-1 fresh weight for the two harvests, respectively. As for the second harvest, the F2 level outperformed and recorded an average of 0.3367

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 https://doi.org/10.54174/utjagr.v13i1.323

mg 100 g-1 fresh weight without a significant difference from the F3 level (0.3156 mg 100 g-1 fresh weight), while the comparison treatment recorded the lowest average for the trait, reaching 0.1700, 0.2300 and 0.1811 mg 100 g-1 fresh weight, respectively, for the three harvests. The reason for the increase in chlorophyll content is due to the increase in nitrogen levels at the F3 level compared to the other levels, in addition to the role of nitrogen in the formation of the chlorophyll molecule (Martines 2017), as well as the contribution of the nitrogen element in increasing the leaf area of the plant, which was positively reflected on Plant performance, because the leaf is considered the primary source of food production for the plant, and this is directly related to the leaf area, and both the nitrogen and phosphorus elements play an important role in increasing the leaf area of the plant, and the more the leaf area increases, the more it intercepts light and forms chlorophyll.

The results of Table 7 show that the third date was superior to the second harvest only and reached 0.308 mg 100 g-1 fresh weight.

The combination F3 × D3 was superior and recorded the highest percentage of chlorophyll, reaching 0.3533, 0.3633 and 0.4033 mg 100 g-1 fresh weight, respectively, for the three harvests. The combination D1 × F0 recorded the lowest average for the trait, reaching 0.1367 and 0.1467 mg 100 g-1 fresh weight, for the first and second harvests, respectively, while the combination F0 × D3 recorded the lowest percentage of chlorophyll for the plant, reaching 0.1533 mg 100 g-1 fresh weight, for the third harvest.

Table (7) Effect of planting dates, NPK fertilizer levels and their interaction on chlorophyll (mg/100 gm-1 fresh weight) of Sudanese grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
	First cut				
D1	0.1367	0.3100	0.3133	0.3367	0.2742
D2	0.1533	0.3100	0.3333	0.3400	0.2842
D3	0.2200	0.2667	0.3033	0.3533	0.2858
LSD	0.03236				NS
	0.1700	0.2956	0.3167	0.3433	
LSD	0.01596				
	second cut				
D1	0.1467	0.1667	0.3500	0.2433	0.2267
D2	0.1567	0.3400	0.3567	0.3400	0.2983
D3	0.2300	0.3467	0.3033	0.3633	0.308
LSD	0.05103				0.02967
	0.1778	0.2844	0.3367	0.3156	
LSD	0.02129				
	Third cut				
D1	0.2100	0.2000	0.3600	0.3667	0.2842
D2	0.1800	0.2567	0.3933	0.3533	0.2958
D3	0.1533	0.2067	0.2867	0.4033	0.2625
LSD	0.05910				NS
	0.1811	0.2211	0.3467	0.3744	
LSD	0.02601				

7- Green fodder yield per cutting (µg ha^{-1}): The F2 and F3 levels were significantly superior at the first harvest and recorded the highest average green fodder yield, reaching 24.740 and 24.370 µg ha-1 , respectively, without a significant difference between them and with an increase rate of 98.400 and 430.95% over the comparison treatment F0, which recorded the lowest yield, reaching 12.470 µg ha-1 , while in the second and third harvests, the F3 level was superior and gave the highest green fodder yield, reaching 44.880 and 20.230 µg ha-1 for the two harvests,

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 https://doi.org/10.54174/utjagr.v13i1.323

respectively, with an increase rate of 114.84% over the F1 treatment (20.890 μg ha-1), which recorded the lowest yield at the second harvest and with an increase rate of 201.49% over the comparison treatment F0 (6.710 μg ha-1), which recorded the lowest yield at the third harvest. The reason for the increase in green fodder yield may be attributed to the role of fertilizer level in enhancing vegetative growth by increasing plant height (Table 2), number of shoots (Table 3), number of leaves (Table 4), leaf area and stem diameter (Table 6), which work together to increase green fodder yield. This result is consistent with what was reached by Jihad (2014) and Ziki (2019), who obtained a significant increase in green fodder yield by increasing nitrogen fertilizer levels for the Sudan grass crop.

It was noted from the results of Table 8 that the second date D2 was superior and gave the highest green fodder yield of 26.720 μg ha-1 in the first cut, while the first date D1 gave the highest average for the trait of 32.160 and 12.840 μg ha-1 respectively for the second and third cuts, while the first date gave the lowest average for the trait of 14.780 μg ha-1 for the first cut, and the third date gave the lowest average for the trait of 23.420 and 11.170 μg ha-1 for the second and third cuts respectively. The reason for the superiority in the green fodder yield may be due to the growth of plants during a time when the climatic factors are suitable, which is positively reflected in the growth of plants in addition to an increase in each of the traits of plant height (Table 2), number of tillers (Table 3), number of leaves (Table 4), and leaf area, which led to an increase in the green fodder yield of the plant. This result was consistent with what was indicated by Ping et al. (2005) The forage yield of Sudan grass crop increases with increasing plant height, number of leaves and leaf area.

The level of F2 fertilizer was superior in the second date, recording the highest green fodder yield, reaching 40.110 μg ha-1 for the first cut, and the level of F3 in the first and second dates (45.920 and 45.910 μg ha-1) without a significant difference between them for the second cut. The combination D3 × F0 recorded the lowest average for the green fodder yield trait, reaching 8.570 and 9.290 μg ha-1 for the first and second cuts, respectively.

Table (8) Effect of planting dates, NPK fertilizer levels and their interaction on the green fodder yield (μg ha-1) of Sudanese grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
	First cut				
D1	12.850	12.820	11.930	21.520	14.780
D2	16.000	19.410	40.110	31.370	26.720
D3	8.570	9.010	22.190	20.220	15.000
LSD	3.453				1.824
	12.470	13.750	24.740	24.370	
LSD	2.185				
	second cut				
D1	22.210	27.490	33.000	45.920	32.160
D2	34.340	23.620	24.670	45.910	32.130
D3	9.290	11.560	30.030	42.800	23.420
LSD	5.692				3.077
	21.950	20.890	29.230	44.880	
LSD	3.386				
	third cut				
D1	5.620	11.460	12.29	22.010	12.840
D2	6.430	8.000	9.91	20.350	11.170
D3	8.080	8.370	9.91	18.330	11.170
LSD	NS				1.535
	6.710	9.280	10.700	20.230	
LSD	1.763				

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319
https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

8-Dry feed yield (µg ha-1): The results of Table 9 showed that the F2 fertilizer level gave the highest dry feed yield of 8.580 µg ha-1 without a significant difference from the F3 level (8.240 µg ha-1) and an increase rate of 97.24 and 89.43% for the F2 and F3 treatments respectively over the comparison treatment which recorded the lowest dry feed yield of 4.35 µg ha-1 for the first cut, while the F3 fertilizer level gave the highest dry feed yield of 15.250 and 6.8710 µg ha-1 respectively for the second and third cuts and an increase rate of 110.345% over the F1 treatment which recorded the lowest dry feed yield in the second cut (7.250 µg ha-1) and the comparison F0 which recorded the lowest yield in the third cut and reached 2.666 µg ha-1 , and an increase rate of 157.726% over The treatment gave the second harvest the lowest average at the F1 level, reaching 7.250 mega grams ha-1. The reason for this increase in dry weight for the three harvests is due to an increase in fertilizer levels that led to an increase in the green fodder yield, which was reflected in the dry fodder yield. This result is consistent with what was reached by Ziki (2019) and Al-Aboudi and Al-Abdullah (2022).

The second date gave the highest average dry fodder yield of 8.900 µg ha-1 for the first cut, while the first date gave the highest average of 10.970 and 4.650 µg ha-1 , respectively, for the second and third cuts, while there was no significant difference from the second date, which recorded a yield of 10.950 and 4.239 µg ha-1 for the second and third cuts, respectively. The first date for the first cut gave the lowest average for the trait of 5.050 µg ha-1 , and the third date for the second and third cuts amounted to 8.440 and 3.896 µg ha-1 , respectively. The reason for the increase in the dry matter yield is due to the increase in the green fodder yield .

The F2 level recorded the highest dry fodder yield in the first harvest with the second date, reaching 13.420 µg ha-1 . In the second harvest, the F3 level outperformed all dates, recording yields of 15.860, 15.330 and 14.550 µg ha-1 for the three dates in succession. In the third harvest, the F3 level outperformed only the first and second dates, recording yields of 7.518 and 7.755 µg ha-1 for the two dates in succession. This shows that the availability of the basic nutrients needed by the plant helped the crop overcome the unfavorable environmental conditions at the late dates and increased the fodder yield.

Table (9) Effect of planting dates, NPK fertilizer levels and their interaction on dry fodder yield (µg ha-1) of Sudanese grass crop

treatments	NPK levels				
Planting date	F0	F1	F2	F3	
	First cut				
D1	4.280	4.620	4.130	7.170	5.050
D2	5.300	6.200	13.420	10.700	8.900
D3	3.470	3.950	8.180	6.84	5.610
LSD		1.469			0.736
	4.350	4.920	8.580	8.240	
LSD		1.033			
	secund cut				
D1	7.780	8.990	11.270	15.860	10.970
D2	11.260	8.390	8.800	15.330	10.950
D3	4.370	4.350	10.490	14.550	8.440
LSD		1.961			1.089
	7.800	7.250	10.190	15.250	
LSD				1.062	
	Third cut				
D1	2.198	3.919	4.965	7.518	4.650
D2	2.668	2.857	3.675	7.755	4.239
D3	3.132	3.295	3.818	5.338	3.896
LSD		0.9130			0.2401

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

LSD	2.666	3.357	4.153	6.871
		0.1987		

III. References:

Abdullah, S. H. ; S. A. Mohammed and H. A. Ali (2021). Effect of planting dates and spacing on the growth and forage yield of Sudan grass hybrid Sorghum Vulgare Var Sudanense Al-Muthanna Journal of Agricultural Sciences 8 (2): 2226-4086

Al-Aboudi, S. B and S. A. Al-Abdullah. (2022). The role of the level and fractionation of nitrogen fertilizer addition in the concentration of N, P and K and the forage yield and quality of Sudan grass hybrid Sorghum Vulgare var. Sudanense. Syrian Journal of Agricultural Research, 9 (5): 317-331.

Al-Azirjawi, M. A. (2020). Effect of planting dates and nitrogen fertilizer levels on the growth, yield and quality of fodder for Panicum maximum cv. Mombasa and Panicum virgatum L. Master's thesis - Department of Field Crops - College of Agriculture - Al-Muthanna University.

Al-Dulaimi, N. M. A. and S. A. H. Al-Nimrawi (2014) The effect of cutting stages and the distance between holes on some growth characteristics and forage yield of white corn, Anbar Journal of Agricultural Sciences Volume: 12 Issue (2): 245234.

Al-Janabi, H. M. J. (2018) Effect of different levels of nitrogen and potassium elements on the growth and yield of white corn. Sorghum bicolor Moench L. Master's thesis - College of Agriculture - Al-Muthanna University.

Al-Sahouki, M. M. (1990) White corn, its production and improvement - Ministry of Higher Education and Scientific Research - University of Baghdad. 216 pp.

Al-Taher, F. M. and H. M. J. Atallah (2019). Response of white corn crop to the addition of nitrogen and potassium fertilizers, Al-Muthanna Journal of Agricultural Sciences 7 (2) 106-113.

Atiya, H. J. and K. M. Wahib. (1989). Understanding crop production Part II. Ministry of Higher Education and Scientific Research, University of Baghdad, translated, p. 1012.

Black, A. L., and Power, J. F. (1965) Effect of chemical and mechanical fallow methods on moisture storage, wheat yields, and soil erodibility. Soil Science Society of America Joumal, 29(4): 465-468.

Casler, M.D., J.F. Pedersen and D.J. Undersander. (2003). Forage yield and economic losses associated with the brown-midrib trait in sudangrass. Crop Sci., 43(3): 782-789.

Goodwin, T.w. (1967). Chemistry and Biochemistry of plant Pgment. 2nd Academic.Press. London. New York. San Francisco. PP: 373.

Jackson, M. L. (1958). Soil chemical analysis. Prentic-Hall Inc. Englewood, Cliffs, N. J., pp 498.

Jiyad Saddam Hakim, Maha Hani Hashim and Sana Qasim (2014) The first date for adding urea to some white corn varieties. Iraqi Journal of Agricultural Sciences, 45(2): 151-156.

Khrbeet, H.K.H., and A.M. Jasim (2015). Effect of Sowing dates and cutting stages on forage yield and quality of Sorghum (Var.Abu Sabeen). The Iraqi Journal of Agricultural Sciences 46 (4), 483-475.

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1(2025) PP 308-319

https://iasj.rdd.edu.iq/journals/journal/issue/15543 *https://doi.org/10.54174/utjagr.v13i1.323*

Mohammed, M.I. (2010). New Sudangrass forage cultivars selected from the original population (Sorghum bicolor 'Garawi', syn. S. sudanense). Afri. J. Range Forage Sci., 27(1): 51-55 .

Page, A. L., Miller, R. H., and Keeney, D. R. (1982). Methods of soil analysis. Part 2. American Society of Agronomy. Soil Science Society of America, Madison, WI, USA, 4(2): 167-179.

Ping, J.; Zhang, F.; Cheng,Q.: Du,Z; Lv. X. and Yuhui Chang, Y.(2005). Performance of One Newly Developed Forage Variety Jincao 1 (Sorghum/sudangrass) in China. Asian J. of Plant Sci., 4(5):527-529

Pratt, P.F., S. Davis, R.G. Sharpless, W.J. Pugh and S.E. Bishop. (1976). Nitrate contents of Sudangrass and Barley forages grown on plots treated with animal manures. Agron. J. 68(2): 311-314.

Raza. H. M. A., Bashir, M. A., Rehim, A., Jan, M. U. H. A. M. M. A. D., Raza, Q. U. A., and Berlyn, G. P. (2021). Potassium and zinc co-fertilization provide new insights to improve maize (Zea mays L.) physiology and productivity. Pak. J. Bot, 5.3(6), 2059-2065.

Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soils. 78(2): 154. LWW.

Somashekar, K.S.; B.G. Shekara; K.N. Kalyanamurthy and H.C. Lohithaswa. (2019). Growth yield and economics of multi-cut fodder sorghum Sorghum sudanense L. as influenced by different seed rates and nitrogen levels. Forage Res. 40(4):247-250.

Venuto, B. and B. Kindiger. (2008). Forage and biomass feedstock production from hybrid forage sorghum and sorghum-sudangrass hybrids. Grassland sci., 54(4): 189-196.

Yang, G., Hu, Z., Hao, Z., Li, J., Wang, Q., Meng, X., ... and Huang, R. (2021) Effect of nitrogen on the metabolic enzyme activity of leaves, protein content and yield of sorghum (sorghum bicolor Moench) in northern china. Appl. Ecol. Environ. Res, 19(5): 3467-3479.

Ziki, S. J. L., Zeidan, E. M. I., El-Banna, A. Y. A., & Omar, A. E. A. (2019). Influence of cutting date and nitrogen fertilizer levels on growth, forage yield, and quality of sudan grass in a semiarid environment. International Journal of Agronomy, 2019(1), 6972639.