Mesopotamia Journal of Agriculture

https://magrj.mosuljournals.com

EFFECT OF SOURCE AND TIMING OF NITROGEN FERTILIZER ADDITION ON GROWTH AND YIELD OF SUDAN GRASS (*Sorghum sudanense* L.)

Salim A. Y. Al-Ghazal [1], Waleed K. S. Al-Juheishy [2]
Field Crops Department, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq1,2

Article information
Article history:
Received: 20/12/2023
Accepted: 21/03/2024
Published: 31/03/2024

Keywords:
Dates for adding nitrogen fertilizers, locations, sudan grass, types of nitrogen fertilizers, yield.

DOI:
https://doi.org/10.33899/mja.2024.145475.1326

Correspondence Email:
salimalghazal@uomosul.edu.iq

ABSTRACT

In the spring of 2022, a field experiment was carried out in two locations: the first was in the village of Al-Thalja, which is located 15 km northwest of the city of Mosul, and the second location was in the village of Al-Shuhada, which is located 30 km west of Mosul. The experiment included two factors, the first two types of nitrogen fertilizer: urea (46%N) and DAP (18%N and 46%P). The second factor included four levels of dividing the two fertilizers: the first level was (half the amount of DAP with planting, the other half after 20 days of planting, and the second was half. The amount of DAP with planting and the other half after 40 days of planting, the third level is half the amount of urea with planting and the other half after 20 days of planting, The fourth level is half the amount of urea with planting and the other half after 40 days of planting). The fertilizer rate used for both types was: 100kg/ha. The experiment was conducted according to a split-plate system with a randomized complete block design (R.C.B.D) with three replications, and the results are summarized as follows: All growth, yield, and qualitative traits of the treatments to which DAP fertilizer was added were superior to those to which urea fertilizer was added in the two study locations. The first fractionation of the DAP fertilizer gave a higher Value for all growth traits, yield, and qualitative traits at the two study locations.

INTRODUCTION

Sudan grass (*Sorghum sudanense* L.) is classified as a type of Sorghum, although some tend to separate it as an independent type of crop of the family, the annual summer-growing Poaceae family (Undersander, 2023). It is grown mainly for the production of forage in large areas in many world countries. It is grown in Iraq in small areas that are not suitable for The importance of this crop, given that it is a crop that tolerates relatively long periods of drought without significant damage (Glamaclija *et al.*, 2010; Awad *et al.*, 2013; Iqbal, 2015; Lima *et al.*, 2017; Basaranet *et al.*, 2017; Al-Habbar *et al.*, 2019; Santin *et al.*, 2020; Singh *et al.*, 2021) In view of the severe shortage in the quantities of forage produced from winter forage crops due to the drought (Ismail *et al.*, 2018; Nosir, 2023) that is afflicting the country, it has become necessary to investigate alternative crops to the traditional crops that are grown as forage crops in Iraq, and the Sudan grass crop is one of the crops that can be expanded in was Planted in Iraq. It is highly productive and produces ten crops during the growing season. It is one of the crops that responds to various agricultural operations, especially nitrogen fertilizer, which has a significant impact on increasing

production through its contribution to cell division and elongation, thus increasing the number of branch plants as well as improving the quality of forage (Bean *et al.*, 2013; Younis *et al.*; Mansour *et al.*, 2017; Machicek, 2018; Kaplan *et al.*, 2019; Ziki et al., 2019; Al-Juheishy and Ghazal, 2023). In order for the plant to benefit maximum from the added amounts, the fertilizer was divided into two batches because, as is known, nitrogen fertilizer sublimates or is (Urea, whether by washing or volatilizing it with ammonia gas) (Marsalis *et al.*, 2010, Ikanoviae *et al.*, 2010; Afzal *et al.*, 2012; Moghimi, and Maghsoudi, 2015; Rolz *et al.*, 2017; AL-Ghazal, 2021; Thuranira *et al.*, 2020; Al-Obady *et al.*, 2022; Ahmad *et al.*, 2022). Accordingly, it is necessary to have an appropriate balance between the amounts. Nitrogen and the timing of its addition to achieve the highest yield and perhaps the lowest amount of nitrogen added at the appropriate time to achieve two benefits: reducing the cost of purchasing nitrogen fertilizer and preserving the environment from pollution. Al-Jubouri (2016) found that the treatment to which nitrogen fertilizer was added in two batches achieved the highest total grain yield in the unit of area is (ton/ha), and Ram and Singh (2001) obtained the best for grain yield of Sudan grass at the nitrogen fertilizer level of 80 kg/ha. Ikanovic *et al.*, (2010) stated that the best production of Sudan grass was achieved at the level of Fertilizer 180 kg/ha. There must be a role for the researcher in choosing the amount of nitrogen fertilizer and the timing of adding it to achieve the highest efficiency of the plant, so this experiment was carried out with the aim of determining the best type of nitrogen fertilizer and the most appropriate timing for adding it according to the stages of plant growth and its relationship to the growth and yield of Sudan grass.

MATERIALS AND METHODS

In the spring of 2022, a field experiment was carried out in two locations: the first was in the village of Al-Thalja, which is located 15 km northwest of the city of Mosul, and the second location was in the village of Al-Shuhada, which is located 30 km west of Mosul. Experiment included two factors, first: were two types of nitrogen fertilizer: urea (46%N) and DAP (Diammonium phosphate) (18%N and 46%P). The second factor included four levels of to divide the two fertilizers: the first level, adding half the amount of DAP with planting and the other half after 20 days of planting. The second level is adding half the amount of DAP with planting and the other half after 40 days of planting. The third level is adding half the amount of urea with planting and the other half after 20 days of planting. The fourth level is adding half the amount of urea with planting and the other half after 40 days of planting. The rate of fertilizer used was for both types. Is: 100 kg/ha. The experiment was carried out according to a split-plot system with a randomized complete block design (R.C.B.D.) with three replications. The levels of each factor were distributed among the experimental units. The types of fertilizer randomly occupied main plots, and the four fertilizer levels occupied sub-plots, and main and secondary plots (units) were separated. Experimental) 1 m apart from each other so that the fertilizer does not transfer between the panels. The experimental land was plowed in two perpendicular plows, smoothed, planted on 1/5/2021, and harvested on 15/8/2021. The experimental unit consisted of 6 lines, 4 m long for each line; additionally, there were 0.4 m between lines 0.2 m between lines, and 20 centimeters between holes. Triple calcium

superphosphate fertilizer (46% P_2O_5) was added at a rate 100 kg/ha at once, scattered before planting. The experiment was watered according to the plant's need. The Haymax cultivar, a Spanish cultivar produced by Vito Company, was used in experiment: Characteristics examined: ten plants were chosen randomly from the midlines of every treatment and were replanted when they reached full flowering. The qualities listed below were examined: Plant height (cm) Number of leaves /plants, Dry forage yield (ton/ha): It was calculated by taking ten plants at random, the leaves were separated from the stems, and dry yield of each was estimated to calculate percentage of leaves. Before being dried at 70°C for 72 hours to stabilize the weight. Total dry matter after collecting yield of leaves and stems and weighing it using an electronic balance. Average dry weight per plant was calculated after dividing total dry weight by ten plants and multiplying result by number of plants per hectare to obtain the total dry matter result. % of protein in leaves, stems and dry forage. And grains: Ground and dried samples were taken from the weight of leaves, stems, dry forage of whole plants, and grains, and the percentage of protein in each was estimated using an Informatics 9500 device, noting that this device works with an infrared system. Number of panicles/plants. After reaching full maturity, ten plants were selected at random from the middle rows, and the number of panicles per plant was determined from these. Weight of panicle seeds (g): Ten randomly selected panicles were weighed individually, and the average weight of the seeds within each panicle was computed to determine the weight of the plant's seeds. Unit: computed by multiplying the weight of panicle seeds by the number of panicles per plant. Calculate the total grain yield by multiplying the plant density (200,000 plant/ha) by the weight of the panicles per plant.

Table (1): Physical and chemical characteristics of the soil at the two locations stady.

Components	Al-Thilga	Al-Shuhada	Units
sand	774	750	$g.kg^{-1}$
Clay	393	497	$g.kg^{-1}$
silt	530	427	$g.kg^{-1}$
	silty clay loam	Silty Clay	
pH	7.5	7.1	
EC . electrical conductivity	1.88	2.4	$ds.m^{-1}$
availability potassium	382.0	256.7	$mg.kg^{-1}$
availability phosphorous	4.0	3.5	$mg.kg^{-1}$
availability nitrogen	54.0	89.0	$mg.kg^{-1}$
Organic matter	1.90	2.06	$mg.kg^{-1}$

RESULTS AND DISCUSSION

Two types of fertilizers' effects on growth characteristics, yield, and quality of Sudan grass crop

Table (2) indicates the significant effect of all growth traits and yields with the two types of DAP and urea fertilizer, with DAP fertilizer being excelled in all the traits that were studied, with a significant difference on urea fertilizer. The treatment to which DAP fertilizer was added gave the highest plant height, number of leaves, and dry forage yield of (167.42). And (158.58) cm, (12.63, 13.53), (9.39, and 10.79) ton/ha at two study location, Al-Shuhada and Al-Thalja, respectively. It is clear from the results that the use of DAP fertilizer (diammonium phosphate was better than urea

fertilizer) and the reason may be due to this fertilizer containing the elements nitrogen and phosphorus, in addition to the presence of nitrogen in the preferred nitrogenous forms for absorption by the plant, and adding phosphorus increases the improvement of the vegetative growth of the plant. (James and Iersel, 2001) It is also clear from the data shown in Table (2) that the treatments to which DAP fertilizer was added were superior in yield traits and components, with a significant difference, to those to which urea fertilizer was added, where the DAP fertilizer treatment gave the highest number of panicles/plants, highest weight and grain /Panicle. Highest individual plant yield and highest total grain yield per unit area reached (2.87 and 2.83) Panicle/plant and (7.41 and 7.37) g and (17.79 and 21.37) g and (3.84 and 4.1) g two study location.

The study and in the previous order, the reason for the superiority of the number of panicles /plant and the weight of panicle grains (g) when adding DAP fertilizer may be due to the same reason mentioned when discussing growth traits. As for the excelled of grain yield per plant and total grain yield with same type of fertilizer (DAP) This may be due to their superiority in number of panicles/plant and the weight of panicle seeds. It is also clear from table that all qualitative traits were significantly affected by addition of two types of nitrogen fertilizer, DAP and Urea, with the exception of % of protein in the leaves at the Al-Shuhada location and % of protein in the stems at the Al-Thaldha location, which the addition of the two kinds of nitrogen fertilizer did not significantly effect.

With DAP fertilizer being superior in all the traits that were studied to for urea fertilizer, the treatments to which dab fertilizer was added gave the highest values for both % of leaves, % protein in leaves, % protein in stems, % protein in the total plant, and % protein in grains (33.83 and 32). and (7.12 and 13.49) and (8.61 and 11.17) and (80.12 and .913) and (80.12 and 13.9) and (10.14 and 13.69). According to the previous order, the superiority of the traits of the treatments to which fertilizer was added may be because It is preferable to those to which urea fertilizer was added for the same reasons mentioned when discussing growth traits.

Table (2): Effect of the two types of manure and urea on the growth traits and yield of Sudan grass crop in the two cultivation locations study

Fertilizer type	Plant height (cm)	Number of leaves/ plant	Dry forage yield (ton/ha)	Number of panicles/ plants	panicle grain weight (g)	Grain yield/ plant (g)	Grain yield (ton/ha)
Al-Thilga location							
DAP	167.42 a	12.63 a	9.39 a	2.87 a	7.41 a	17.79 a	3.84 a
Urea	158.58 b	11.39 b	7.67 b	2.23 b	6.1 b	10.51 b	2.25 b
Al-Shuhada location							
DAP	187.60 a	13.53 a	10.79 a	2.83 a	7.37 a	21.37 a	4.10 a
Urea	173.11b	13.06 a	9 .20 b	2.01b	6.28 b	12.88 b	2.58 b

Table (3): Effect of the two types of fertilizer DAP and Urea on the qualitative traits of Sudan grass crop in the two cultivation locations study

Fertilizer type	leaves %	protein % in leaves	protein % in stem	Protein % in dry forage	protein % in grains
Al-Thilga location					
DAP	33.83b	12.74a	8.61a	12.80a	14.10a
Urea	31.83 a	11.16b	8. 23a	12.35b	12.71a
Al-Shuhada location					
DAP	32.19a	13.49a	11.71a	13.9a	13.69a
Urea	30.61b	12.79a	10.10b	12.07b	12.72b

Effect of splitting fertilizers on the growth and yield of Sudan grass

The two fertilizers' fractionation treatments differ significantly, according to the data in Table (4), urea and DAP. If the Sudan grass plant to which DAP fertilizer is added in two batches, half amount with planting and other half after 20 days of planting, is higher for plant height, number of leaves, and dry forage yield of (159.50). And 177.83) cm, (12.10, 13.87), (7.25, and 10.80) tons/ha at the Al-Thalja and Al-Shuhada location, respectively.

This significant increase may be due to the improvement of the plant's ability to carry out various processes (non-absorption), including absorption. This is due to the vital role that nitrogen plays in the plant. This fertilizer also contains phosphorus in addition to nitrogen, which leads to improving the traits of vegetative growth and increasing the absorption of nutrients (James and Iersel 2001). plants known as Sudan grass, to which urea fertilizer was applied in two portions: half at planting and the other half forty days later, recorded the lowest values for plant height, number of leaves, and dry forage yield of (176.12 and 189.0) cm, 11.85 and 13.17, and (6.28 and 10.43) tons/ha at the Al-Thalja and Al-Shuhada location, respectively.

The Sudan grass plant to which DAP fertilizer was added in two batches, half of amount with planting and other half after 20 days of planting, recorded the highest values for number of panicles/plants, highest seed weight/panicle, highest individual plant yield, and the highest yield. Total grains per unit area amounted to (2.90 and 2.83) panicle/plant, 8.78 and 7.30) g, (17.38 and 21.16) g, and (3.45 and 4.16) tons/ha in the two study location and in the previous order. Plants were recorded Sudan grass with urea fertilizer added to it in two batches, half the quantity with planting and the other half after 40 days of planting.

The lowest values for the number of panicles/plants, highest grain weight/panicle, highest individual plant yield, and the highest total grain yield per unit area reached (2.25 and 2.20) Panicle/plant, 8.32 and 6.63 g, 11.24 and 18.88 g, and 2.59 and 2.99 tons/ha in the two study location. And in the previous order. The superiority of individual plant yield and total grain yield at first segmentation level may be due to its excellence in the number of panicles/ plant and weight of panicle grains. Table (5) shows notable variations between fractionation coefficients of urea and DAP fertilizers. If the Sudan grass plant to which DAP fertilizer is added in two batches, half amount with planting and other half 20 day after planting, the highest values are % for leaves, % for protein in the stem, and % for protein. In dry forage, the percentage of protein in grains reached (33.7, 32.3), (8.9, 11.88), (13.17, 13.27),

(1714, and 13.7 %) in the Al-Thalja and Al-Shuhada location, respectively. This significant increase may be due to the same reasons mentioned when discussing the traits of growth and yield.

Table (4): Effect of splitting the two fertilizers (DAP and urea) on the growth traits and yield of Sudan grass crop in the two study locations.

Partitioning fertilizer	Plant height (cm)	Number of leaves/ plants	Dry forage yield (ton/ha)	Number of panicles/plants	panicle grain weight (g)	Grain yield per plant (g)	Grain yield (ton/ha)
Al-Thilga location							
First	167.12 a	12.10 a	7.25 a	2.90 a	8.72 a	17.38 a	3.45 a
Second	b 46.82	12.09 a	7.25 b	2.68 b	8.65 a	14. 81 b	3.18 a
Third	161.12 c	11.95 a	6.68 b	2.37 c	8.45 b	13.18 c	2.74 b
Fourth	159.50 d	11.85 a	6.28 c	2.25 c	8.32 b	11.24 d	2.59 b
Al-Shuhada location							
First	189.00 a	13.87 a	10.80 a	2.83 a	7.30 a	21.16 a	4.16 a
Second	183.00 b	13.27 b	10.42 b	2.68 b	7.03 b	18. 63 b	3.75 b
Third	178.83 c	13.15 b	10.17 b	2.43 c	6.88 c	17.04 c	3.43 c
fourth	177.83 c	13.17 b	10.43 c	2.20 d	6.63 d	18.88 c	2.99 d

Table (5): Effect of splitting the two fertilizers (DAP and urea) on the qualitative traits of Sudan grass crop in the study

Partitioning fertilizer	Leaves %	protein % in leaves	Protein % in stem	protein % in dry forage	protein % in grains
Al-Thilga location					
First	33.70 a	12.25 a	8.90 a	13.17 a	14.17 a
Second	33.38 a	12.75 a	8.73 a	12.73 b	13.58 b
Third	31.90 b	11.57 b	8.03 b	12.73 b	13.20 bc
Fourth	31.00 b	11.22 b	8.00 b	11.73 c	12.70 c
Al-Shuhada location					
First	32.33 a	12.19 b	11.88 a	13.27 a	13.70 a
Second	31.07 a	13.60 a	10.88 b	12.90 a	13.57 a
Third	31.47 a	13.27 ab	11.22 b	12.47 a	13.03 b
Fourth	31.17 a	13.15 ab	10.43 b	12.45 a	12.95 b

Effect of the interaction between the two types of fertilizer and their Partitioning on growth traits, yield, and quality of Sudan grass crop in the two locations

The data in tables (6, 7, 8, and 9) show that the interaction between the two types of fertilizer and their fractionation was significant for all the traits studied and in the two study location. If the interaction between DAP fertilizer and the first split treatment gave highest values of plant height, number of leaves, dry forage yield, number of panicles/plants, weight of panicle seeds, grain yield per plant, and total grain yield reached (170.34 and 197.0) cm, (12.83, 14.13) and (9.77). And 11.5) tons/ha, (2.93, 2.97), (7.80, 7.73) g, (20.40, 23.67) g, and (3.97, 4.59) tons/ha in the two study locations, in the previous order. The interaction between urea fertilizer and the fourth fractionation treatment gave the lowest values for the traits mentioned above in the two study locations if they reached (159.34 and 171.0) cm, (11.17 and

14.13), (7.47 and 9.43 (tons/ha), and (1.67, 1.77) and (5.77 and 5.93 g and (6.89 and 10.83) g (1.98, 1.57). The interaction between DAP fertilizer and the first fractionation treatment gave highest value of % of leaves, % of protein in leaves, % of protein in dry forage, and % of protein in grains, reaching (34.60 and 43.33) cm, (8.93 and .5312), and (13.63 and 13.70). (.8314 and 14.40) and in the previous order.

The interaction between urea fertilizer and the fourth split treatment gave the lowest values of % for leaves, % for protein in leaves and % for protein in stem if they reached (47.28 and 27.30) and (10.73 and 53.12). (7.50 and 9.27) sequentially in two study locations, Al-Taljah and Al-Shuhada.

Table (6): Effect of the interaction between the two types of fertilizer, urea and DAP, and their Partitioning fertilizer, on the growth traits and yield of Sudan grass at the Al-Thalja location.

Fertilizer type	Partitioning fertilizer	Plant height (cm)	Number of leaves/ plants	Dry forage yield (ton/ha)	Number of panicles/ plants	panicle grain weight (g)	Grain yield/ plant (g)	Grain yield (ton/ha)
DAP	first	170.67 a	12.83 a	9.77 a	2.93 a	7.80 a	20.40 a	3.97 a
	second	167.34 b	12.73 a	9.50 a	2.87 a	7.57 ab	17.65 b	3.87 a
	third	166.00 c	12.5 3 a	9.17 b	2.87 a	7.47 b	17.52 b	3.61 a
	fourth	165.67 c	12 .40 a	9.13 c	2.87 a	6.8 c	15 .58 c	3.60 a
Urea	first	163.37 d	11.77 b	7.80 d	2.80 a	6.70 c	14.53 d	2.92 b
	second	161.00 e	11.3 bc	7.77 d	2.50 b	5.90 d	11.96 e	2.59 b
	third	156.34 f	11.3 bc	7.67 de	1.86 c	5.90 d	8.43 f	1.88 c
	fourth	159.34 g	11.17 c	7.47 e	1.77 c	5.77 d	6.89 g	1.57 c

Table (7): effect of the interaction between the two types of fertilizer and their Partitioning fertilizer on the growth traits and yield of Sudan grass on the Al-Shuhada location

Fertilizer type	Partitioning fertilizer	Plant height (cm)	Number of leaves/ plants	Dry forage yield (ton/ha)	Number of panicles/ plants	panicle grain weight (g)	Grain yield/ plant (g)	Grain yield (ton/ha)
DAP	first	197 .00 a	14.13 a	11.50 a	2.97 a	7.73 a	23.67 a	4.59 a
	second	190.00 b	13.73ab	11.2 ab	2.90 ab	7.47 b	21.67 b	4.37 a
	third	185.34 c	13.60 b	10.80 b	2.87 ab	7.47 b	21.41 b	4.28 ab
	fourth	184.67 c	13.53 b	10.33 c	2.73 b	7.33 b	21.37 b	4.00 bc
Urea	first	181.00 d	13.46 b	10. 10 c	2.70 b	6.87 c	18.66 c	3.70 c
	second	176.00 e	12.80 c	9.63 d	2.40 c	6.60 d	15.88 d	3.22 d
	third	172.34 f	12.77 c	9.53 d	1.97 d	6.30 e	12.44 f	3.48 e
	fourth	171.00 f	12.77 c	9.43 e	1.67 e	5.93 f	10.38 e	1.98 f

Table (8) Effect of the interaction between the two types of fertilizers Urea and DAP and their Partitioning fertilizer on the quality traits of Sudan grass crop at Al-Thilga location

Fertilizer type	Partitioning fertilizer	leaves %	protein % in leaves	protein % in stem	Protein % in dry forage	protein % in grains
DAP	First	34.60 a	13.07 ab	8.93 a	13.63 a	14.83 a
	Second	34.03 a	13.67 a	8.80 ab	12.73 bc	14.50 a
	Third	33.53 a	12.40 bc	8.20 abc	12.97 b	13.70 b
	Fourth	33.17 a	11.83 c	8.50 ab	11.90 c	13.33 bc
Urea	First	32.80 a	11.43 bc	8.87 a	12.90 d	13.4 bc
	Second	32.72 a	11.83 c	8.68 a	12.73 bc	12.67 cd
	Third	30.63 b	10.73 d	7.87 bc	12.50 bc	12.70 cd
	Fourth	28.47 c	10.60 d	7.50 c	11.57 d	12.07 d

Table (9): Effect of the interaction between the two types of fertilizers Urea and DAP and their Partitioning fertilizer on the quality traits of Sudan grass crop at Al-Shuhada location

Fertilizer type	Partitioning fertilizer	leaves %	protein % in leaves	protein % in stem	Protein % in dry forage	protein % in grains
DAP	First	33.43 a	12.77 c	12.53 a	13.70 a	14.40 a
	Second	31.17 bc	14.13 a	11.30 a	13.27 ab	14.27 a
	Third	32.13 ab	13.73 ab	11.87 ab	13.27 ab	13.50 b
	Fourth	32.97 a	13.76 ab	11.60 b	12.90 abc	13.27 bc
Urea	First	31.23 bc	13.03 bc	11.23 bc	12.83 abc	13.00 bc
	Second	30.97 bc	13.03 bc	10.47 d	12.53 bcd	12.87 bc
	Third	30.60 bc	12.80 c	10.57 cd	11.67 d	12.63 d
	Fourth	30.27 c	12.53 c	9.27 e	12. cd	12.63 d

CONCLUSIONS

From this experiment, we can conclude that at the two study locations, the treatments treated with DAP fertilizer produced higher growth traits, yields, and qualitative traits than those treated with urea fertilizer. All growth traits, yields, and qualitative traits in the two study locations showed higher values with the first Partitioning fertilizer of DAP fertilizer.

ACKNOWLEDGMENT

The researchers expressed their gratitude to the College of Agriculture and Forestry / University of Mosul for their assistance in completing this research.

CONFLICT OF INTEREST

The researcher affirms that this work does not conflict with the interests of others.

تأثير مصدر وموعد اضافة السماد النتروجيني في نمو وحاصل الحشيش السوداني (*Sorghum sudanense* L.)

سالم عبد الله يونس الغزال [1]، وليد خالد شحاذة الجحيشي [2]
قسم المحاصيل الحقلية / كلية الزراعة والغابات / جامعة الموصل / الموصل / العراق [1،2]

الخلاصة

نفذت تجربة في ربيع عام 2022، أجريت تجربة ميدانية في موقعين: الأول في قرية الثلجة التي تقع على بعد 15 كم شمال غرب مدينة الموصل، والموقع الثاني في قرية الشهداء والتي تقع على بعد 30 كم غرب الموصل. تضمنت التجربة عاملين، الأول نوعين من الأسمدة النتروجينية: اليوريا (N%46) و DAP 18% (N و P 46%). أما العامل الثاني فقد تضمن أربعة مستويات لتقسيم السمادين: (المستوى الأول: نصف كمية الـ DAP مع الزراعة، والنصف الآخر بعد 20 يوماً من الزراعة، والمستوى الثاني: نصف مقدار الـ DAP مع الزراعة والنصف الآخر بعد 40 يوم من الزراعة، المستوى الثالث: نصف كمية اليوريا مع الزراعة والنصف الآخر بعد 20 يوم من الزراعة، المستوى الرابع: نصف كمية اليوريا مع الزراعة والنصف الآخر بعد 40 يوم من الزراعة). وكانت نسبة الأسمدة المستخدمة لكلا النوعين: 100 كغم/هكتار. نفذت التجربة وفق نظام الألواح المنشقة بتصميم القطاعات العشوائية الكاملة (R.C.B.D) بثلاثة مكررات، وتتلخص النتائج فيما يلي: جميع صفات النمو والحاصل والصفات النوعية للمعاملات التي أضيف إليها سماد DAP كانت متفوقة على تلك التي أضيف إليها سماد اليوريا في موقعي الدراسة. أعطت التجزئة الأولى لسماد DAP قيماً أعلى لجميع صفات النمو والحاصل والصفات النوعية في موقعي الدراسة.

الكلمات المفتاحية: مواعيد اضافة الاسمدة النيتروجينية، المواقع، الحشيش السوداني، انواع الاسمدة النيتروجينية، الحاصل.

REFERENCES

Afzal, M., Ahmad, A., and Ahmad, A. U. H. (2012). Effect of nitrogen on growth and yield of sorghum forage (*Sorghum bicolor* (L.) Moench cv.) under three cuttings system. https://repository.uaiasi.ro/xmlui/handle/20.500.12811/2322

Ahmad, I., Zhu, G., Zhou, G., Song, X., Hussein Ibrahim, M. E., and Ibrahim Salih, E. G. (2022). Effect of N on growth, antioxidant capacity, and chlorophyll content of sorghum. *Agronomy*, *12*(2), 501. https://doi.org/10.3390/agronomy12020501

AL-Ghazal, S. A. (2021). Nitrogen fertilizer and effect of forage grass crops: Article review. *Mesopotamia Journal of Agriculture*, *49*(4). https://doi.org/10.33899/magrj.2021.130762.1135

Al-Habbar, M. T., Hussein, A. S., Al-Bayati, J. M., A. S. Al-Dabbagh, M. M. Hamdoun (2019). Study the possibility of using two types of chemical compound fertilizers (with or without bio-fertilizer) as alternative to urea fertilizer in quantity and quality of lettuce (*Lactuca sativa* L.) NADERC. *Mesopotamia Journal of Agriculture*, *47*. https://www.iasj.net/iasj/article/188388

Al-Jubouri, O. A. A. (2016). *Response of Corn Yield (Zea Mays L.) And Its Components for Fractionating the Addition of Nitrogen Fertilizer And Removing The World Leaf Under The Cob*, PhD thesis, College of Agriculture and Forestry, University of Mosul. https://www.iasj.net/iasj/download/957fda1eb4b06b4e

Al-Juheishy, W., & Ghazal, S. (2023). Role of nano-fertilizers in improving productivity of peanut crop: A review. *Mesopotamia Journal of Agriculture*, *51*(4), 13-27. https://doi.org/10.33899/mja.2023.142680.1266 .

Al-Obady, R. F. A., Ghazal, S. A. Y., and Al-Juheishy, W. K. S. (2022). Effect of some agricultural process on growth and yield of sorghum (*Sorghum bicolor* L.) (ARTICLE REVIEW). *Mesopotamia Journal of Agriculture*, *50*(4), 117-126. https://doi.org/10.33899/magrj.2022.136718.1206 .

Awad, A., Hafiz, S., Hammada, M. S., El-Nouby, A., and El-Hendawy, S. (2013). Grain yield production of Sudan grass (*Sorghum sudanense* (Piper) Stapf) as influenced by cutting numbers, potassium rates, and intrarow spacing in a semiarid environment. *Turkish Journal of Agriculture and Forestry*, *37*(6), 657-664. https://doi.org/10.3906/tar-1208-53

Basaran, U., Dogrusoz, M. C., Gulumser, E., and Hanife, M. U. T. (2017). Hay yield and quality of intercropped sorghum-sudan grass hybrid and legumes with different seed ratio. *Turkish Journal of Field Crops*, *22*(1), 47-53. https://doi.org/10.17557/tjfc.301834

Bean, B. W., Baumhardt, R. L., McCollum Iii, F. T., and McCuistion, K. C. (2013). Comparison of sorghum classes for grain and forage yield and forage nutritive value. *Field Crops Research*, *142*, 20-26. https://doi.org/10.1016/j.fcr.2012.11.014

Glamoclija, D., Jankovic, S., Rakic, S., Maletic, R., Ikanovic, J., and Lakic, Z. (2011). Effects of nitrogen and harvesting time on chemical composition of biomass of Sudan grass, fodder sorghum, and their hybrid. *Turkish Journal of Agriculture and Forestry*, *35*(2), 127-138. https://doi.org/10.3906/tar-0911-58

Ikanović, J., Glamočlija, Đ., Maletić, R., Popović, V., Sokolović, D., Spasić, M., and Rakić, S. (2011). Path analysis of the productive traits in Sorghum species. *Genetika-Belgrade*, *43*(2), 253-262. https://doi.org/10.2298/GENSR1102253I

Iqbal, M. A. (2015). Agronomic management strategies elevate forage sorghum yield: A Review. *J Adv Bot Zoo*, *3*, 1-6. https://scienceq.org/agronomic-management-strategies-elevate-forage-sorghum-yield-a-review.php

Ismail, S. M., El-Nakhlawy, F. S., and Basahi, J. M. (2018). Sudan grass and pearl millets productivity under different irrigation methods with fully irrigation and stresses in arid regions. *Grassland Science*, *64*(1), 29-39. https://doi.org/10.1111/grs.12179

James, E., and van Iersel, M. (2001). Ebb and flow production of petunias and begonias as affected by fertilizers with different phosphorus content. *HortScience*, *36*(2), 282-285. https://doi.org/10.21273/HORTSCI.36.2.282

Kaplan, M. A. H. M. U. T., Kara, K. A. N. B. E. R., Unlukara, A., Kale, H. A. S. A. N., Beyzi, S. B., Varol, I. S., ... and Kamalak, A. (2019). Water deficit and

nitrogen affects yield and feed value of sorghum Sudan grass silage. *Agricultural Water Management*, *218*, 30-36. https://doi.org/10.1016/j.agwat.2019.03.021

Lima, M. H. M., Pires, D. A. D. A., Moura, M. M. A., Costa, R. F., Rodrigues, J. A. S., and Alves, K. A. (2017). Nutritional characteristics of Sorghum hybrids hay (*Sorghum sudanense* vs. *Sorghum bicolor*). *Acta Scientiarum. Animal Sciences*, *39*, 229-234. https://doi.org/10.4025/actascianimsci.v39i3.32524

Machicek, J. A. (2018). *Evaluating forage sorghum and pearl millet for forage production and quality in the Texas high plains* (Doctoral dissertation). http://hdl.handle.net/11310/158

Mansour, E., Merwad, A. M. A., Yasin, M. A. T., Abdul-Hamid, M. I. E., El-Sobky, E. E. A., and Oraby, H. F. (2017). Nitrogen use efficiency in spring wheat: Genotypic variation and grain yield response under sandy soil conditions. *The Journal of Agricultural Science*, *155*(9), 1407-1423. https://doi.org/10.1017/S0021859617000600

Marsalis, M. A., Angadi, S. V., and Contreras-Govea, F. E. (2010). Dry matter yield and nutritive value of corn, forage sorghum, and BMR forage sorghum at different plant populations and nitrogen rates. *Field Crops Research*, *116*(1-2), 52-57. https://doi.org/10.1016/j.fcr.2009.11.009

Moghimi, N., and Maghsoudi, K. (2015). Growth and yield responses of two forage sorghum cultivars to different nitrogen fertilizer rates. *Iran Agricultural Research*, *34*(1), 39-45. https://doi.org/10.22099/iar.2015.3041

Nosir, W. (2023). Climate change: consequences on iraq's environment. *Mesopotamia Journal of Agriculture*, *51*(2). https://doi.org/10.33899/magrj.2023.140391.1243

Ram, S. N., and Singh, B. (2001). Effect of nitrogen and harvesting time on yield and quality of sorghum (*Sorghum bicolor*) intercropped with legumes. *Indian Journal of Agronomy*, *46*(1), 32-37. https://www.indianjournals.com/ijor.aspx?target=ijor:ijaandvolume=46andissue=1andarticle=007

Rolz, C., de León, R., de Montenegro, A. L. M., Porras, V., and Cifuentes, R. (2017). A multiple harvest cultivation strategy for ethanol production from sweet sorghum throughout the year in tropical ecosystems. *Renewable Energy*, *106*, 103-110. https://doi.org/10.1016/j.renene.2016.12.036

Santin, T. P., Frigeri, K. D. M., Agostini, A., da Silva, H. R., Frigeri, K. D. M., Kalles, N. Z., ... and Dias, A. M. (2020). Fermentative characteristics and chemical composition of sorgo silage (*Sorghum bicolor*) with use of absorbents additives. *Brazilian Journal of Development*, *6*(8), 54931-54943. https://doi.org/10.34117/bjdv6n8-057

Singh, S. R., Singh, M. K., Meena, K., and Vishwakarma, S. P. (2021). Effect of different NPK levels on fodder production of sudan grass (Sorghum bicolor var. Sudanese). *International Journal of Bio-resource and Stress Management*, *12*(3), 199-204. http://dx.doi.org/10.23910/1.2021.2229

Thuranira, JK, T., AM, K., Ouma, J. P., and Kamau, C. K. (2020). Effects of Cutting Time and Varieties on Fodder Grain Yields and Yield Components of Sorghum under Semi Arid Environments of Makueni County in Kenya. *International*

Journal of Sciences: Basic and Applied Research, 24(5),309-324. http://41.89.96.81:8080/xmlui/handle/123456789/2705

Undersander, D. (2003). Sorghums, Sudangrasses, and sorghum-Sudan hybrids. *Focus Forage, 5*(5). https://forages.org/Resources/Sorghums-UW.pdf

Younis, S. A., Al-Hassan A. M. (2019). Effect of nitrogen fertilization and growth phases on the qualitative characteristics of fodder for five varieties *Avena sativa* L.). *Mesopotamia Journal of Agriculture 47,* Supplement II, 2019 Proceedings of the 3rd International Agri. Conference, College of Agri. and Forestry, Univ., of Mosul and College of Agri. Engineering Sciences, Univ., of Duhok 2-3 October 2019. https://www.iasj.net/iasj/download/a7fe46ed1968b3a5

Ziki, S. J. L., Zeidan, E. M. I., El-Banna, A. Y. A., and 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*, 1-9. https://doi.org/10.1155/2019/6972639