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, Iraq 1,2

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, smooth, 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% P₂O₅) 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 study.

<table>
<thead>
<tr>
<th>Components</th>
<th>Al-Thilga</th>
<th>Al-Shuhada</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>sand</td>
<td>774</td>
<td>750</td>
<td>g.kg⁻¹</td>
</tr>
<tr>
<td>Clay</td>
<td>393</td>
<td>497</td>
<td>g.kg⁻¹</td>
</tr>
<tr>
<td>silt</td>
<td>530</td>
<td>427</td>
<td>g.kg⁻¹</td>
</tr>
<tr>
<td></td>
<td>silty clay loam</td>
<td>Silty Clay</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.5</td>
<td>7.1</td>
<td>ds.m⁻¹</td>
</tr>
<tr>
<td>EC . electrical conductivity</td>
<td>1.88</td>
<td>2.4</td>
<td>mg.kg⁻¹</td>
</tr>
<tr>
<td>availability potassium</td>
<td>382.0</td>
<td>256.7</td>
<td>mg.kg⁻¹</td>
</tr>
<tr>
<td>availability phosphorous</td>
<td>4.0</td>
<td>3.5</td>
<td>mg.kg⁻¹</td>
</tr>
<tr>
<td>availability nitrogen</td>
<td>54.0</td>
<td>89.0</td>
<td>mg.kg⁻¹</td>
</tr>
<tr>
<td>Organic matter</td>
<td>1.90</td>
<td>2.06</td>
<td>mg.kg⁻¹</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>Plant height (cm)</th>
<th>Number of leaves/plant</th>
<th>Dry forage yield (ton/ha)</th>
<th>Number of panicles/plants</th>
<th>panicle grain weight (g)</th>
<th>Grain yield/plant (g)</th>
<th>Grain yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Thilga location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>167.42 a</td>
<td>12.63 a</td>
<td>9.39 a</td>
<td>2.87 a</td>
<td>7.41 a</td>
<td>17.79 a</td>
<td>3.84 a</td>
</tr>
<tr>
<td>Urea</td>
<td>158.58 b</td>
<td>11.39 b</td>
<td>7.67 b</td>
<td>2.23 b</td>
<td>6.1 b</td>
<td>10.51 b</td>
<td>2.25 b</td>
</tr>
<tr>
<td>Al-Shuhada location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>187.60 a</td>
<td>13.53 a</td>
<td>10.79 a</td>
<td>2.83 a</td>
<td>7.37 a</td>
<td>21.37 a</td>
<td>4.10 a</td>
</tr>
<tr>
<td>Urea</td>
<td>173.11b</td>
<td>13.06 a</td>
<td>9.20 b</td>
<td>2.01 b</td>
<td>6.28 b</td>
<td>12.88 b</td>
<td>2.58 b</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>leaves %</th>
<th>protein % in leaves</th>
<th>protein % in stem</th>
<th>Protein % in dry forage</th>
<th>protein % in grains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al-Thilga location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>33.83b</td>
<td>12.74a</td>
<td>8.61a</td>
<td>12.80a</td>
<td>14.10a</td>
</tr>
<tr>
<td>Urea</td>
<td>31.83a</td>
<td>11.16b</td>
<td>8.23a</td>
<td>12.35b</td>
<td>12.71a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al-Shuhada location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>32.19a</td>
<td>13.49a</td>
<td>11.71a</td>
<td>13.9a</td>
<td>13.69a</td>
</tr>
<tr>
<td>Urea</td>
<td>30.61b</td>
<td>12.79a</td>
<td>10.10b</td>
<td>12.07b</td>
<td>12.72b</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Partitioning fertilizer</th>
<th>Plant height (cm)</th>
<th>Number of leaves/plants</th>
<th>Dry forage yield (ton/ha)</th>
<th>Number of panicles/plants</th>
<th>Panicle grain weight (g)</th>
<th>Grain yield per plant (g)</th>
<th>Grain yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Thilga location</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>167.12 a</td>
<td>12.10 a</td>
<td>7.25 a</td>
<td>2.90 a</td>
<td>8.72 a</td>
<td>17.38 a</td>
<td>3.45 a</td>
</tr>
<tr>
<td>Second</td>
<td>46.82 b</td>
<td>12.09 a</td>
<td>7.25 b</td>
<td>2.68 b</td>
<td>8.65 b</td>
<td>14.81 b</td>
<td>3.18 a</td>
</tr>
<tr>
<td>Third</td>
<td>161.12 c</td>
<td>11.95 a</td>
<td>6.68 b</td>
<td>2.37 c</td>
<td>8.45 b</td>
<td>13.18 c</td>
<td>2.74 b</td>
</tr>
<tr>
<td>Fourth</td>
<td>159.50 d</td>
<td>11.85 a</td>
<td>6.28 c</td>
<td>2.25 c</td>
<td>8.32 b</td>
<td>11.24 d</td>
<td>2.59 b</td>
</tr>
<tr>
<td>Al-Shuhada location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>189.00 a</td>
<td>13.87 a</td>
<td>10.80 a</td>
<td>2.83 a</td>
<td>7.30 a</td>
<td>21.16 a</td>
<td>4.16 a</td>
</tr>
<tr>
<td>Second</td>
<td>183.00 b</td>
<td>13.27 b</td>
<td>10.42 b</td>
<td>2.68 b</td>
<td>7.03 b</td>
<td>18.63 b</td>
<td>3.75 b</td>
</tr>
<tr>
<td>Third</td>
<td>178.83 c</td>
<td>13.15 b</td>
<td>10.17 b</td>
<td>2.43 c</td>
<td>6.88 c</td>
<td>17.04 c</td>
<td>3.43 c</td>
</tr>
<tr>
<td>Fourth</td>
<td>177.83 c</td>
<td>13.17 b</td>
<td>10.43 c</td>
<td>2.20 b</td>
<td>6.63 d</td>
<td>18.88 c</td>
<td>2.99 d</td>
</tr>
</tbody>
</table>

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

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

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.

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>Partitioning fertilizer</th>
<th>Plant height (cm)</th>
<th>Number of leaves/plants</th>
<th>Dry forage yield (ton/ha)</th>
<th>Number of panicles/plants</th>
<th>Panicle grain weight (g)</th>
<th>Grain yield/plant (g)</th>
<th>Grain yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAP</td>
<td>first</td>
<td>170.67 a</td>
<td>12.83 a</td>
<td>9.77 a</td>
<td>2.93 a</td>
<td>7.80 a</td>
<td>20.40 a</td>
<td>3.97 a</td>
</tr>
<tr>
<td></td>
<td>second</td>
<td>167.34 b</td>
<td>12.73 a</td>
<td>9.50 a</td>
<td>2.87 a</td>
<td>7.57 a</td>
<td>17.65 b</td>
<td>3.87 a</td>
</tr>
<tr>
<td></td>
<td>third</td>
<td>166.00 c</td>
<td>12.5 3 a</td>
<td>9.17 b</td>
<td>2.87 a</td>
<td>7.47 b</td>
<td>17.52 b</td>
<td>3.61 a</td>
</tr>
<tr>
<td></td>
<td>fourth</td>
<td>165.67 c</td>
<td>12.40 a</td>
<td>9.13 c</td>
<td>2.87 a</td>
<td>6.8 c</td>
<td>15.58 c</td>
<td>3.60 a</td>
</tr>
<tr>
<td>Urea</td>
<td>first</td>
<td>163.37 d</td>
<td>11.77 b</td>
<td>7.80 d</td>
<td>2.80 a</td>
<td>6.70 c</td>
<td>14.53 d</td>
<td>2.92 b</td>
</tr>
<tr>
<td></td>
<td>second</td>
<td>161.00 e</td>
<td>11.3 bc</td>
<td>7.77 d</td>
<td>2.50 b</td>
<td>5.90 d</td>
<td>11.96 e</td>
<td>2.59 b</td>
</tr>
<tr>
<td></td>
<td>third</td>
<td>156.34 f</td>
<td>11.3 bc</td>
<td>7.67 de</td>
<td>1.86 c</td>
<td>5.90 d</td>
<td>8.43 f</td>
<td>1.88 c</td>
</tr>
<tr>
<td></td>
<td>fourth</td>
<td>159.34 g</td>
<td>11.17 c</td>
<td>7.47 e</td>
<td>1.77 c</td>
<td>5.77 d</td>
<td>6.89 g</td>
<td>1.57 c</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>Partitioning fertilizer</th>
<th>Plant height (cm)</th>
<th>Number of leaves/plants</th>
<th>Dry forage yield (ton/ha)</th>
<th>Number of panicles/plants</th>
<th>Panicle grain weight (g)</th>
<th>Grain yield/plant (g)</th>
<th>Grain yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAP</td>
<td>first</td>
<td>197.00 a</td>
<td>14.13 a</td>
<td>11.50 a</td>
<td>2.97 a</td>
<td>7.73 a</td>
<td>23.67 a</td>
<td>4.59 a</td>
</tr>
<tr>
<td></td>
<td>second</td>
<td>190.00 b</td>
<td>13.73ab</td>
<td>11.2 ab</td>
<td>2.90 ab</td>
<td>7.47 b</td>
<td>21.67 b</td>
<td>4.37 a</td>
</tr>
<tr>
<td></td>
<td>third</td>
<td>185.34 c</td>
<td>13.60 b</td>
<td>10.80 b</td>
<td>2.87 ab</td>
<td>7.47 b</td>
<td>21.41 b</td>
<td>4.28 ab</td>
</tr>
<tr>
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<td>184.67 c</td>
<td>13.53 b</td>
<td>10.33 c</td>
<td>2.73 b</td>
<td>7.33 b</td>
<td>21.37 b</td>
<td>4.00 bc</td>
</tr>
<tr>
<td>Urea</td>
<td>first</td>
<td>181.00 d</td>
<td>13.46 b</td>
<td>10. 10 c</td>
<td>2.70 b</td>
<td>6.87 c</td>
<td>18.66 c</td>
<td>3.70 c</td>
</tr>
<tr>
<td></td>
<td>second</td>
<td>176.00 e</td>
<td>12.80 c</td>
<td>9.63 d</td>
<td>2.40 c</td>
<td>6.60 d</td>
<td>15.88 d</td>
<td>3.22 d</td>
</tr>
<tr>
<td></td>
<td>third</td>
<td>172.34 f</td>
<td>12.77 c</td>
<td>9.53 d</td>
<td>1.97 d</td>
<td>6.30 e</td>
<td>12.44 f</td>
<td>3.48 e</td>
</tr>
<tr>
<td></td>
<td>fourth</td>
<td>171.00 f</td>
<td>12.77 c</td>
<td>9.43 e</td>
<td>1.67 e</td>
<td>5.93 f</td>
<td>10.38 e</td>
<td>1.98 f</td>
</tr>
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</table>
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

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

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

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>Partitioning fertilizer</th>
<th>leaves %</th>
<th>protein % in leaves</th>
<th>protein % in stem</th>
<th>Protein % in dry forage</th>
<th>protein % in grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAP</td>
<td>First</td>
<td>33.43 a</td>
<td>12.77 c</td>
<td>12.53 a</td>
<td>13.70 a</td>
<td>14.40 a</td>
</tr>
<tr>
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<td>Second</td>
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<td>14.13 a</td>
<td>11.30 a</td>
<td>13.27 ab</td>
<td>14.27 a</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>32.13 ab</td>
<td>13.73 ab</td>
<td>11.87 ab</td>
<td>13.27 ab</td>
<td>13.50 b</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>32.97 a</td>
<td>13.76 ab</td>
<td>11.60 b</td>
<td>12.90 abc</td>
<td>13.27 bc</td>
</tr>
<tr>
<td>Urea</td>
<td>First</td>
<td>31.23 bc</td>
<td>13.03 bc</td>
<td>11.23 bc</td>
<td>12.83 abc</td>
<td>13.00 bc</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>30.97 bc</td>
<td>13.03 bc</td>
<td>10.47 d</td>
<td>12.53 bcd</td>
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</tr>
<tr>
<td></td>
<td>Third</td>
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<td>10.57 cd</td>
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<tr>
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<td>Fourth</td>
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<td>12.53 c</td>
<td>9.27 e</td>
<td>12. cd</td>
<td>12.63 d</td>
</tr>
</tbody>
</table>

**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 ومعدع اضافة السماد النيتروجيني في نمو وحاصول الحشيش السوداني

Sorghum sudanense L.)

سلمى عبد الله يونس الغزال 1، ولد خالد شحاذة الجحيشي 2
قسم المحاصيل الحقلية / كلية الزراعة والغذاء / جامعة الموصل / الموصل / العراق

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الخلاصة

نفذت تجربة في ربيع عام 2022، أجريت تجربة ميدانية في مواقعين: الأول في قرية الثلجة التي تقع على بعد 15 كم شمال غرب مدينة الموصل، والموقع الثاني في قرية الشهداء التي تقع على بعد 30 كم غرب الموصل. تضمنت التجربة عاملين، الأول نوعين من الأسمدة النيتروجينية: اليوريا (N46%) و DAP 18% (N و P46%). أما العامل الثاني فقد تضمن أربعة مستويات لتقسيم السمادين: (المستوى الأول: نصف كمية DAP مع الزراعة، والنصف الآخر بعد 20 يوم من الزراعة، والمستوى الثاني: نصف كمية 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 لكل النوعين: 100 كغم/هكتار. نفذت التجربة وفق نظام الألواح المنشفة بتصميم القطاعات العلوانية الكاملة (R.C.B.D) ثلاثة مكررات، وتلخص النتائج فيما يلي: جميع صفات النمو والحاصل والصفات النوعية للمععاملات التي أضيف إليها سماد DAP كانت متفوقة على تلك التي أضيف إليها سماد اليوريا في موقع الدراسة. أعطت التجربة الأولى لسماد DAP فيما أعلى لجميع صفات النمو والحاصل والصفات النوعية في موقع الدراسة.

الكلمات المفتاحية: مواعيد اضافة الأسمدة النيتروجينية، الموقع، الحشيش السوداني، انواع الأسمدة النيتروجينية، الحاصل.

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