Effect of Nitrogen and Phosphorus Fertilization on Yield and Some Growth Parameters of Sudangrass (*Sorghum sudanese*) Crop

Manal A. Asker

College of Agriculture / Univ. of Basrah
E-mail: manal.asker@uobasrah.edu.iq

Abstract

A field experiment was conducted to study the effect of nitrogen (0,200 and 300 kg N ha\(^{-1}\)) and phosphorus (0,60, and 180 kg P ha\(^{-1}\)) fertilization and their combination on yield and some growth parameters of sudangrass (*Sorghum Sudanese*). (Number of leaves per plant, plant height, number of heads per plant, weight of 1000 seeds, yields of seeds, dry weight of shoots, and protein content in seeds) were measured. Results indicated that nitrogen and phosphate application and their combination had significant effects on all growth parameters and yield of Sudangrass. The combination treatment of 300 kg N ha\(^{-1}\) plus 180 kg P ha\(^{-1}\) gave a higher yield (71.86 g plant\(^{-1}\)) and protein content in seeds (5.79%) and other growth parameters.

Key words: Nitrogen, Phosphorus, Sudangrass, Chemical composition.

Introduction

Sudangrass (*Sorghum Sudanese*) is one of many important short-term forage crops of summer season, which is important for livestock farming (Li et al., 2011). The crop grows successfully in almost every type of soil, but it does best on loams. Sandy soil is generally unfavorable for crop production (Kilcer et al., 2002). Fertilizer requirements of sudangrass are usually similar to those of other annual grass crops. Nitrogen is the most limiting nutrient in Sudangrass production. The direct response of the plant to nitrogen fertilizer is increasing in green forage yield and protein content. Also N enhances the growth of shoot and makes the fodder juicy that is essential for fodder crop (Khalied and Muhammad, 2003). Kilcer et al., (2002) found that Nitrogen application increased yield of Sudangrass and improved its yield components. Nitrogen application significantly increased total green biomass, protein content and nitrogen concentration of leaves of Sudangrass (Hazary et al., 2015).

Phosphorus fertilizer has affected sudangrass production both in quality and quantity (Vashishtha and Dwivedi, 1997). Phosphorus moves slowly in soil, so applying it before planting is necessary for plant...
growth (Keshwa and Jat, 1992). It is important of energy component (ATP, Adenosine triphosphate, and ADP, Adenosine diphosphate) (Mengel and Kinkby, 1982). Hazary et al., (2015) found significant effect of P fertilization on yield of Sudangrass planted in Bangladesh.

Information regarding the optimum level of N and P and their effective combination on sudangrass growth and productivity is rare. The objective of this study was to evaluate the effect of different levels of nitrogen and phosphorus fertilizer on yield and some growth parameters of Sudan grass planted in calcareous soil in Basrah.

**Materials and Methods**

The experiment was carried out in a private field in Abul-Khasseb, Basrah province during the 2014-2015 season. Soil samples properties were taken and analyzed according the method described by Black (1965); Jackson (1958); and Page et al., (1982) (table 1).

Three different levels of nitrogen (0, 200, and 300) kg N ha⁻¹ as urea fertilizer (46% N), and three levels of phosphorus (0, 60, and 180 kg P ha⁻¹) as concentrated super phosphate (20.21% P), and their combination were used to investigate their effects on some growth parameters and yield of Sudangrass. The experimental design used was a complete randomized block design with a split plot in three replicates. Nitrogen treatments were represented a main blocks, while a phosphate treatments were presented a sub treatment. A seeding rate of kg ha⁻¹. Seeds were sown in row. The experimental design was plot (3*4m) and divided to rows. The space between row was 30 cm. Phosphate fertilizer and first dose of nitrogen were added as broadcasting of rows at planting date 1st April 2014. The second dose of nitrogen was added after one month of planting with irrigation water. Growth parameters such as number of leaves, plant height (cm), number of seeds, and weight of 1000 seeds were measured before harvest (1st Aug. 2014). Dry weight of shoots was taken after drying in oven at 65°C. Yield of seeds was taken for each treatment. Protein content was calculated according to the method mentioned by Crasser and Parson (1979). Comparisons between means were made using least significant differences (L.S.D.) test at 5% levels of probability by using SPSS program version (16).
### Table (1) : Some chemical and physical properties of the field soil.

| Property                          | Value  | Unit     |
|----------------------------------|--------|----------|
| pH                               | 7.28   |          |
| Electrical Conductivity (EC_e)   | 5.80   | dSm⁻¹    |
| Cation Exchange Capacity (CEC)   | 26.20  | meq.kg⁻¹ |
| Calcium Carbonate                | 335.63 |          |
| Organic matter                   | 11.70  | gm.Kg⁻¹  |
| Total Nitrogen                   | 1.79   |          |
| Available Nitrogen               | 22.50  | gm.Kg⁻¹  |
| Available Phosphate              | 15.45  |          |
| Soil Particles                   |        |          |
| Sand                             | 91.5   | gm kg⁻¹  |
| Silt                             | 513.5  |          |
| Clay                             | 395.0  |          |
| Soil texture                     |        | silty clay loam |

**Results and Discussion**

Results in figures (1 and 2) showed significant effect of nitrogen application on growth parameters studied of Sudangrass. Highly significant effect of N application was found at 300 kg N ha⁻¹ for all growth parameters. Maximum yield of seed was obtained at 300 kg N ha⁻¹ (66.22 gm.plant⁻¹) with increasing percentage 25% and 30% and 8.15% for 200 kg N ha⁻¹ and control treatments. Protein content in seeds reached 5.107% for 300 kg N ha⁻¹ level with increasing percentage of 10.37% and 32.75% for 200 kg N ha⁻¹ levels as compared with control treatment. This means that applying large quantities of nitrogen has significant effect on Sudan grass yield and supplying plant with sufficient quantity of plant growth by increasing of available nitrogen in soil which might have enhanced growth of Sudan grass. These results agreed with the results of Hazary et al.,(2015).
Fig(1): Effect of N application on number of leaves per plant(A), plant height (B), number of heads per plant (C) and weight of 1000 seed (D) of Sudangrass
Fig(2): Effect of N application on yield of seeds (A), dry weight (B) and protein content in seeds (C) of Sudan grass

Significantly (P 0.05) effect was observed when applying phosphorus at 60 and 120 kg P ha⁻¹ on growth parameters, yields, seeds and protein when compared with control treatment (Figs 3 and 4). This means that applying phosphate fertilizer increased available phosphate in soil and its uptake by plant. Yield of Sudan grass seeds at different P fertilizer treatment was 54.16, 60.35 and 66.05 gm plant⁻¹ in respect to control treatment respectively, while protein content for the same treatments was 3.993, 4.433, and 5.063% respectively. Phosphate increased root growth and its development and increased of nutrients uptake (Vashishthaan Dwived, 1997). Similar result was found by Khaleduzzman et al., (2007).

Results in table 2 showed the combination effect of nitrogen and
phosphate fertilization on growth parameters, yields and protein content of Sudan grass seeds. Statistical analysis showed significant (0.05) effect due to the combination of nitrogen and phosphate fertilization. Highest number of leaves, plant height, numbers of heads, weight of 1000 seed, yield of seeds, dry matter, and protein content in seeds was reached at the (300 kg N ha⁻¹ plus 180 kg P ha⁻¹) combination treatment as compared with other treatments, which were (2600 leaf plant⁻¹, 341.66 cm, 7.83 head plant⁻¹, 26.04 gm, 71.86 gm plant⁻¹, 34.10 gm plant⁻¹, and 5.790%) respectively. Similar result were stated by Awan and Abbasi (2000) who found that increasing levels of P and N fertilizers increased nitrogen and phosphate uptake by Sudan grass. This results indicate that protein content and yields of Sudan grass seeds increased significantly with the increase of N of P fertilization. The finding of this study can be used by farmers and research for fulfilling the production demand from Sudan grass in Iraq.
Fig(3): Effect of P application on (No. of leaves plant(A) , plant height (B), No. of heads . plant$^{-1}$(C) and weigh of 1000 seed (D)) of Sudangrass

Fig(4): Effect of P application on yield of seeds (A), dry weight (B) and protein concentration in seeds (C) of Sudangrass
Table (2): Effect of nitrogen and phosphate fertilization and their combination on some growth parameters and yield of Sudan grass.

| Treatments | No. of leaves .plant<sup>1</sup> | Plant Height (cm) | No. of Heads .plant<sup>1</sup> | Weight. of 1000 seed (gm) | Yield of seeds (gm) | Dry. matter gm .plant<sup>1</sup> | Protein in seeds (%) |
|------------|---------------------------------|-------------------|---------------------------------|---------------------------|---------------------|--------------------------|----------------------|
| Control    | 19.77a                          | 260.89a           | 3.33a                           | 13.51a                    | 43.45a              | 19.83a                   | 3.440a               |
| N1         | 19.77a                          | 263.33ab          | 3.58abc                         | 15.42a                    | 53.11b              | 20.41a                   | 3.900a               |
| N2         | 21.84ab                         | 264.88ab          | 4.30abc                         | 16.03a                    | 61.99d              | 22.88ab                  | 4.200b               |
| p1         | 19.91a                          | 259.66a           | 4.33abc                         | 16.31a                    | 57.45c              | 22.83ab                  | 4.180ab              |
| P2         | 21.66ab                         | 274.44c           | 6.08bc                          | 21.35b                    | 62.76d              | 25.07bc                  | 4.500c               |
| N1p1       | 27.20b                          | 270.83bc          | 7.49cd                          | 24.54bc                   | 64.30d              | 27.20c                   | 5.200e               |
| N1p2       | 23.66ab                         | 276.55c           | 6.61a                           | 22.55bc                   | 61.62d              | 28.17c                   | 4.360c               |
| N2p1       | 25.10b                          | 277.77c           | 7.37d                           | 24.77bc                   | 65.17d              | 33.66d                   | 4.900d               |
| N2P2       | 26.00b                          | 341.66d           | 7.83d                           | 26.04c                    | 71.86e              | 34.10e                   | 5.790f               |
| LSD(0.05)  | 4.577                           | 7.980             | 2.901                           | 3.595                     | 4.13                | 3.544                    | 0.149                |

References

Awan, ZI, Abbasi MK (2000). Interactive effect of phosphorus and copper on maize growth. Pakistan J. Agri. Res. 16(2): 105-108.

Black, C. A (1965). Methods of soil analysis, part 1. Physical properties. Amer. Soc. Agron. Inc. Pub Madison, USA.

Crasser, M.S. and J.W.Parson (1979). Sulfuric-perchloric acid digestion on plant material for the determination of nitrogen, phosphorus, potassium, calcium and Magnesium. Anul. Chem. Acta, 109: 431-436.

Hazary, M.E.H. Bilkis, Z.H. Khandker, M.A.Akbar. and A.B.M.Khaleduzzaman (2015). Effect of nitrogen and phosphate fertilization on yield and nutritional quality of jumbo grass (Sorghumgrass x sudangrass). Advances in animal and Veterinary Sciences J. 3: 444-450.

Jackson, M.L. (1958). Soil chemical analysis. Prentic. Hall. Inc. Engle wood cliffs, N.S. USA.

Keshwa, GL, Jat PC (1992). Effect of phosphorus and zinc quality and fodder production of summer pearl millet (Pennisetum glaucum). Indian J. Agri. 37(1-2): 118-120.

Khalied M, Ijaz A, Muhammad A (2003). Effect of nitrogen and phosphorus on the fodder yield and quality of two sorghum cultivars (Sorghum bicolor L.). Int. Agri. Biol. 5(1): 61-63.
Khaleduzzaman ABM, Islam N,Khandaker ZH,Akbar MA (2007) .Effect of different doses of nitrogen and phosphorus fertilizer on yield and quality of Napier grass (Pennisetum purpureum) .Bangladesh J.Anim.Sci.,36(1-2):41-49.

Kilcer , T., Q. Ketterings, T.Kats Vairo, and J.Cherney (2002). Nitrogen management for Sorghum sudangrass how to optimize N uptake Efficiency What s Cropping up 212 (5) : 6-9.

Li. W., L. J . Wei , L. F. Bai , W Yan,L. Ming and L. X. Kun (2011) Fertilization regimes effect the soil biological characteristics of a sudangrass and ryegrass rotation system. Sci. china life Sc : 54 : 572-579.

Mengel , K. and E.A. Kirkby (1982). Principles of plant nutrition. 2nd ed. Inter. Potash Inst. Bern, Switzerland.

Page AL, Miller RH, Keeney DR (1982).Methods of Soil analysis,Part-2Amer.Soc. Agron. Inc. Soil.So Soc.Amer. Inc.Medison Wisconsin, USA.pp. 152-531.

Vashihatha RP, Dwivedi DK (1997).Effect of nitrogen and phosphorus on "MP chari" sorghum. Indian J. Agron., 42(1): 112-115.

تأثير التسميد النتروجيني والفوسفاتي في الحاص وبعض مؤشرات النمو لحصول (Sorghum Sudanese)

منال عبد الله عسكر
كلية الزراعة / جامعة البصرة

الخلاصة

نفذت تجربة حقلية لدراسة تأثير التسميد النتروجيني ( صفر ، 200 ، 300 كغم نتروجين . هكتار 1) والفوسفاتي ( صفر ، 60 ، 180 كغم فسفور . هكتار 1) والتداخل بينهما في حاصل وبعض مؤشرات النمو ( عدد الأوراق،نبات 1، نباتات 1، ارتفاع النباتات،عدد الرووس.نبات 1، وزن 1000 حبة، حاصل الحبوب، الوزن الجديد للمجموع الخضري ومحتوى البروتين في الحبوب ) لمحصول الحشيش السودانى المزرعة في تربة طينية مزجية غربية في اد حقول محافظة البصرة في ابي الخصيب خلال الموسم 2014-2015. بينما النتائج بأن التسميد النتروجيني والفوسفاتي والتداخل بينهما تأثير معيّن في حاصل الحبوب. لمحصول الحشيش السوداني وجميع مؤشرات النمو وقد حققت المحاولة ( 300 كغم نتروجين. هكتار 1 + 180 كغم فسفور. هكتار 1) اعلى انتاج للحبوب ( 71.86 عنبة 1) واعلى تركيز للتروجين اذ بلغ 5.79% هذا بالإضافة إلى مؤشرات النمو الأخرى.

الكلمات المفتاحية: التسميد النتروجيني والفوسفاتي، الحشيش السودانى.