British Journal of Global Ecology and Sustainable Development
Volume-17, June, 2023
ISSN (E): 2754-9291

THE EFFECT OF NITROGEN FERTILIZATION AND CUTTING HEIGHT ON THE DRY MATTER PERCENTAGE AND QUALITY OF WHITE CORN CROP SORGHUM BICOLOR L.

Hadi Sadoon Kadhim AL-skini
Dr. Mohammed Abdul-Raza Abdul Wahed and Dr. Kadhim Kutame Jaber
Department of Field Crop, College of Agriculture, University of Basrah, Iraq.
*e-mail : hadi04445@gmail.com

Abstract

A field experiment was conducted during the spring season 2021-2022 in the field of the College of Agriculture, University of Basra / Karmat Ali site (latitude 30°.57 north and longitude 47°.80) in order to study the effect of five levels of nitrogen fertilizer (0, 150, 200, 250 and 300) kg N ha^{-1} and three levels of cutting height (10, 20 and 30) cm in the percentage of dry matter and its quality for the white corn crop Sorghum bicolor L. In a mixture of alluvial soil, as planting took place on 1/4/2022, the experiment was applied according to the method Factorial experiments using the randomized complete block design (R.C.B.D) with three replications. The different factorial coefficients were distributed to the workers randomly within each sector. Three bunches of crop were taken and the following characteristics were measured for each bunch: percentage of dry matter and percentage of protein in the plant, percentage of fiber in the plant, the results showed The level of nitrogen fertilizer was superior to 250 kg N ha^{-1} , which recorded the highest average percentage of protein in the plant, which reached 13.26, 12.08, and 9.24 %, and the highest average dry matter percentage reached 25.98, 28.67, and 28.23 % for the three weeds, while the relationship between the protein percentage and the fiber percentage was inversely By increasing the percentage of protein in the plant, the percentage of fiber in the plant decreases. The results also showed that the cutting height of 10 cm recorded the highest average percentage of protein in the plant, which reached 10.71, 9.46, and 7.71% for the three cuttings, respectively, and the highest average percentage of dry matter in the plant reached 28.15 % in the second cutting. While the effect of the interaction between nitrogen fertilization and cutting height was significant, as the overlap treatment of 250 kg N ha^{-1} with a cutting height of 10 cm recorded the highest average percentage of protein in the plant amounted to 14.38 and 10.21% for the first and second cuttings, and the highest average percentage of dry matter reached 28.93% for the cuttings. the second.

Introduction

The interest in cultivating fodder crops is one of the important things to increase the amount of green fodder in the summer. The availability of fodder in the conditions of the southern region is a prerequisite for the success of any animal field. To increase the yield of green and dry fodder, attention must be paid to fertilization processes for its main role in increasing the yield, as the importance of nitrogen lies Being one of the main nutrients and positively affecting the growth of forage crops by increasing plant

Journal Zone Publishing, Ilford, United Kingdom

height, number of cuttings, number of leaves and leaf area, thus increasing the yield of green and dry forage, as noted when adding this element to poor soils that suffer from a lack of nitrogen leads to improved growth and thus increased accumulation of dry matter in plants (Tena and Beyene, 2011and Aragaw et al., 2020).

The nitrogen element is very important for the growth of crops, especially white corn, because it is a large-sized grassy crop that stresses the soil, as it participates with magnesium in the formation of chlorophyll as well as its entry into the formation of enzymes, hormones and vitamins, in addition to raising the efficiency of plants in water consumption and resistance to external stresses, as it is included in the composition of Amino and nucleic acids, and its deficiency leads to yellowing of the leaves and accelerates the aging of the leaves and the short life cycle of the plant, and that most plants need the element nitrogen in large quantities compared to the rest of the other elements to build their tissues because it is essential in the synthesis and representation of proteins and protoplasm and the formation of chlorophyll (Abu Dahi and Younis, 1988). When a deficiency occurs in the levels of this element, it will affect the growth of the plant because it enters into the action of auxins and cytokines, which have a role in increasing the division of meristematic cells and thus increasing the ability of the plant to absorb the necessary elements from the soil such as nitrogen, phosphorus and potassium, and this positively affects the increase in green fodder yield. It was also observed that the addition of the nitrogen element leads to an increase in plant density, which is something desirable in fodder crops (Zand et al, 2014), that the final outcome of the role of nitrogen is an increase in the process of photosynthesis and results in the formation of shoots and an increase in plant height, number of leaves and leaf area, and these are indicators of growth It is considered essential in increasing the yield of green fodder crops, and the nitrogen element increases the size of the leaves that are a plant for nutrients, which leads to an increase in biomass and thus an increase in the forage yield of the plant (Ziki et al, 2019).

Another process that affects the physiological processes of forage crops is the level of cutting height, which has a role in the growth of forage crops, as it helps to re-grow the plant again while retaining vitality that enables it to re-energize the plant after cutting without affecting the physiological processes, in addition to the side branches that Affected by this process to ensure that the shoots are not exposed to drought and heat after cutting the plants, and thus negatively or positively affect the forage yield (Kharbit and Hashem, 2017). Research indicates that dry matter yield is higher at shorter cut heights compared to leaving taller straw, while other research shows that an increase in forage cut height improves the nutritional composition of silage. However, dry forage yield losses can become very large if very high elevations are used. For mowing, this mowing strategy is not accepted by producers (Granados-Nino et al, 2020). and this study was built, which aims to determine the best level of nitrogen fertilizer that gives the highest dry matter in the plant, while determining the ideal level for cutting the plant.

Journal Zone Publishing, Ilford, United Kingdom

Materials and Methods

A field experiment was carried out at the agricultural research station of the College of Agriculture - University of Basra / Karma Ali site, which is located at (latitude 30°.57 north and length 47°.80) during the spring agricultural season 2021-2022 The study aimed to find out the effect of five levels of nitrogen fertilizer and three cut-off heights in the percentage and quality of dry matter for the sorghum bicolor L crop. In alluvial mixture soils shown in Table (1). The experiment included the study of two factors, the first factor, five levels of nitrogen fertilizer (0, 150, 200, 250 and 300) kg N ha^{-1} which is denoted by (N_0, N_1, N_2, N_3 and N_4) respectively and The source of nitrogen fertilizer is urea fertilizer, which contains (46%) nitrogen, and urea fertilizer was added in three batches, the first batch after a week after germination, the second batch after the first mower and the third batch after the second mower, and the second factor included three levels of cutting height (10, 20 and 30) cm and symbolized by the symbol (C_1, C_2 and C_3) sequentially, the experiment was applied according to the method of factor experiments using the design of complete random sectors (R.C.B.D) with three repeats that distributed the different factor coefficients of workers randomly within each sector (Al-Rawi and Khalaf Allah, 1980), the land was divided into panels and according to the design used with an area of 3x 2 m = 6 m 2 per board and each board contains four lines, the distance between one line and the last 50 cm and the distance between the holes is 20 cm (Abdullah et al., 2021). The seeds of sorghum plants were sown on 1/4/2022, three fillings of the crop were taken, and the percentage of dry matter was calculated through the following equation (1975 A.O.A.C):

Dry matter percentage = dry sample weight / wet sample weight x 100

The protein percentage was calculated through the following equation:

protein % = N% x 6.25 (Peter and Young , 1980)

The percentage of fiber was estimated according to the following equation: (1975 A.O.A.C)

$$\textbf{Fiber \%} = \frac{\text{weight after drying + Weight after burning}}{\text{sample weight}} \times 100$$

Table (1) some physical and chemical properties for the soil.

Unit	Value	Adjectives	
–	7.31	**pH**	
$Ds.m^{-1}$	8.69	**E.C**	
$Mg.Kg^{-1}$	1.82	**Organic matter**	
$Mg.Kg^{-1}$	28.12	**N**	**Available elements**
	10.21	**P**	
	90.45	**K**	
$g.Kg^{-1}$ Soil	135	**Sand**	**Soil articulations**
	515	**Silt**	
	350	**Clay**	
1000		**Silt loam**	**The texture**

Journal Zone Publishing, Ilford, United Kingdom

Results and Discussion

1_Percentage of protein in the plant(%)

It was noted from Table (2) that there were significant differences between the fertilizer levels, as the N_3 level recorded the highest average of protein content in the plant, which reached 13.26, 12.08, and 9.24% for the first, second, and third plant cuts, respectively, which differed significantly from the rest of the levels and for all plant cuts, while the comparison treatment recorded N_0 less average reached 5.69, 5.49 and 5.28% for the three plant cuts, respectively. The reason is that the increase in nitrogen uptake in the plant led to an increase in the representation of compounds resulting from photosynthesis and their conversion into proteins due to the conversion of ketone organic acids into amino acids through enzymatic reactions. Chain of acids are associated with peptide bonds to form proteins (Mengel and Kirkby, 1982 and Amandeep, 2012).

The results of Table (2) indicated that the C_1 level was superior for the three plant cuts , as the highest average of protein content in the plant was recorded at 10.71, 9.46 and 7.71% for the three pant cuts and respectively, which differed significantly from the rest of the levels at the first and third plant cauts, while the second plant cut did not differ significantly from the level C_2, which recorded 8.88%, while the C_3 level recorded the lowest average for the first and second plant cuts, 8.50 and 8.46%, while for the third plant cut, the C_2 level recorded the lowest average of 6.54%. The reason for the increase in the percentage of protein in the plant is due to an increase in the number of leaves that contain The highest levels of protein compared to other plant parts. (Al_Ferjawi, 2014 and Szymanska and et al , 2018).

The interaction between nitrogen fertilization and high cuttings significantly affected the protein content of white corn plants at the first and second plant cuts, as the treatment N_3C_1 recorded the highest average of 14.38%, which differed significantly from the rest of the levels at the first plant cut. While treatment N_0C_2 recorded the highest average which reached 13.12% . Meanwhile the N_3C_2 treatment recorded the highest average which reached 13.12 %. While N_0C_3 treatment recorded the lowest average for first and second plant cuts which reached 5.42 and 5.21%.

Table (2) Effect of nitrogen fertilization, cutting height and the interaction between them on the average percentage of plant protein (%)

Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
10.71	12.92	14.38	11.88	8.13	6.25	C_1	First
9.33	11.04	13.33	9.38	7.50	5.42	C_2	
8.50	8.75	12.08	8.75	7.50	5.42	C_3	

Journal Zone Publishing, Ilford, United Kingdom

	10.90	13.26	10.00	7.71	5.69	Fertilization mean	
For interaction 0.951	For Fertilization 0.549			For Cutting Height 0.425		0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
9.46	12.92	10.42	10.00	8.12	5.83	C_1	Second
8.88	10.00	13.12	8.54	7.29	5.42	C_2	
8.46	9.58	12.71	8.75	6.04	5.21	C_3	
	10.83	12.08	9.10	7.15	5.49	Fertilization mean	
For interaction 1.360	For Fertilization 0.785			For Cutting Height 0.608		0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
7.71	7.92	10.21	8.33	6.67	5.42	C_1	Third
6.54	6.67	8.75	6.67	5.42	5.21	C_2	
6.62	6.88	8.75	6.88	5.42	5.21	C_3	
	7.15	9.24	7.29	5.83	5.28	Fertilization mean	
For interaction N.S	For Fertilization 0.932			For Cutting Height 0.722		0.05 LSD	

2_ Percentage of fiber in the plant (%)

It was noted from Table (3) that there were significant differences between the fertilizer levels, as level N_1 recorded the highest average of fiber content in the plant, which reached 14.86% for the first plant cut, which did not differ significantly from level N_0, which recorded 14.83%, while at the second and third plant cut, the N_0 level recorded the highest average percentage of fibers in the plant, which was reached 18.33 and 14.57% for the two plant cuts, respectively, which differed significantly from the rest of the levels, meanwhile the N_4 level recorded the lowest average percentage of fiber in the plant whoch reached 14.18% for the first plant cut , while at the second and third plant cuts, the N_2 level recorded the lowest average of 16.99 and 13.69 % for the two plant cutts respectively and the reason for the increase in fiber is when the plant ages, the aging of the leaves increases and the accumulation of carbohydrates increases. Therefore, the nitrogen-free substances increase, such as the percentage of lignin,

Journal Zone Publishing, Ilford, United Kingdom

hemicellulose, and cellulose, and these are the main components of the fibers (Al-Moazani and Al-Taie, 2014).

As for the plant cutting height, Table (3) shows that the C_3 level gave the highest average of the fiber content in the plant, reaching 15.53, 18.97, and 15.30% for the first, second, and third plant cuts, respectively, which differed significantly from the rest of the levels, and the C_1 level recorded the lowest average of 13.58, 16.02, and 13.50. % for the first, second and third plant cuts, respectively.

As for the effect of the interaction between nitrogen fertilization and plant cutting height, it was significant at the third plant cut only, as the treatment N_0C_3 recorded the highest average of fiber content in the plant which reached 15.79%, which differed significantly from the rest of the levels, while the treatment of interlocking N_2C_1 recorded the lowest average of 13.12%.

Table (3) Effect of nitrogen fertilization, cutting height and the interaction between them on average plant fiber content (%)

Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
13.58	13.21	13.39	13.69	13.91	13.70	C_1	First
14.46	14.12	14.27	14.27	14.81	14.85	C_2	
15.53	15.23	15.13	15.49	15.86	15.95	C_3	
	14.18	14.26	14.49	14.86	14.83	Fertilization mean	
For interaction N.S	For Fertilization 0.166		For Cutting Height 0.128			0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
16.02	15.80	15.72	15.55	16.18	16.84	C_1	Second
17.50	17.19	17.17	17.44	17.61	18.08	C_2	
18.97	18.68	18.85	17.99	19.25	20.08	C_3	
	17.23	17.25	16.99	17.68	18.33	Fertilization mean	
For interaction N.S	For Fertilization 0.499		For Cutting Height 0.387			0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		Third

13.50	13.54	13.87	13.12	13.39	13.60	C_1	
14.24	14.15	15.59	13.19	13.96	14.32	C_2	
15.30	15.54	15.10	14.76	15.28	15.79	C_3	
	14.41	13.86	13.69	14.21	14.57	Fertilization mean	
For interaction 0.174	For Fertilization 0.100		For Cutting Height 0.078			0.05 LSD	

3_ Percentage of dry matter (%)

The results of Table (4) showed that the fertilizer level of 250 kg N ha^{-1} gave the highest average percentage of dry matter in the plant, reaching 25.98 , 28.67 and 28.23 % for the first, second, and third plant cut, respectively. It did not differ significantly from N_2 and N_1, which recorded 25.73 and 25.14% at the first batch, and at the second and third batch, it differed significantly from the rest of the levels., which reached 23.560, 26.456, and 26.256% for the three plant cut. It has a positive effect on leaf area and number of leaves, thus increasing dry matter accumulation in the plant (Fageria and Baligar, 2005 and Al-Aboudi and Al-Abdullah, 2022).

As for the effect of plant cutting height, Table (4), it was significant at the second and third plant cutting only, as the plant cutting height 10 cm recorded the highest average of the dry matter percentagel in the plant, which reached 28.15% at the second plant cut, and it differed significantly from the rest of the levels, and the level 30 cm was the highest average at the third cutting. 27.84%,

The interlocting between nitrogen fertilization and plant cutting height significantly affected the percentage of dry matter at the second and third plant cuts only, as the treatment recorded 250 kg N ha^{-1} with a plant cutting height of 10 cm, the highest average of 28.93 %, and it did not differ significantly from four other treatments.

Table (4) Effect of nitrogen fertilization, cutting height and the interaction between them on the average dry matter percentage (%)

Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})					Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0		
24.91	25.27	25.90	25.53	24.73	23.10	C_1	First
25.25	24.87	26.03	25.70	25.63	24.00	C_2	
24.91	23.97	26.00	25.97	25.07	23.57	C_3	
	24.70	25.98	25.73	25.14	23.56	Fertilization mean	

For interaction N.S	For Fertilization 1.19		For Cutting Height N.S		0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})				Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0	
28.15	27.60	28.93	28.90	28.20	27.13	C_1
27.13	25.13	28.76	27.86	27.13	26.76	C_2
27.00	27.23	28.33	27.73	26.23	25.46	C_3
	26.65	28.67	28.16	27.18	26.45	Fertilization mean
For interaction 0.83	For Fertilization 0.48		For Cutting Height 0.37		0.05 LSD	
Cutting Height mean	Nitrogen Fertilization (Kg N ha^{-1})				Cutting Height	Cuttings
	N_4	N_3	N_2	N_1	N_0	
26.72	27.40	27.66	27.23	26.66	24.66	C_1
27.28	26.63	28.26	27.23	27.26	27.03	C_2
27.84	27.70	28.76	28.16	27.53	27.06	C_3
	27.24	28.23	27.54	27.15	26.25	Fertilization mean
For interaction 0.70	For Fertilization 0.40		For Cutting Height 0.31		0.05 LSD	

Second

Third

Conclusions and Recommendations

We conclude from the above that the level exceeded 250 kg N ha^{-1}, which recorded the highest average percentage of protein and percentage of dry matter, as well as with regard to the effect of plqnt cutting height, the cutting height exceeded 10 cm in percentage of protein in plants and percentage of dry matter, but as for the percentage of fiber in plants decreases with increasing percentage Protein in plants is an inverse relationship. We recommend cutting sorghum at a height of 10 cm with the addition of nitrogen fertilizer at the level of 250 kg N ha^{-1} to obtain the highest dry matter in the plant.

References

1. Abdullah, Salam Hamid, Sundus Abdul Karim Muhammad, and Haitham Abdul Salam Ali. (2021). Effect of planting dates and distances between crops on the growth and forage yield of hybrid Sorghum vulgare Var. Sudanense. Al-Muthanna Journal of Agricultural Sciences, 8 (2): 2226-4086.

Journal Zone Publishing, Ilford, United Kingdom

2. Kharbit, Hamid Khalaf and Khaleda Ibrahim Hashem. (2017). Forage crops. Ministry of Higher Education and Scientific Research, University of Baghdad, College of Agriculture. P p 298.
3. Al-Farajawi, Taghreed Mahmoud Khudair and Ali Farhoud Nasser. (2014). Effect of intercropping and nitrogen fertilizer on forage yield and quality of white corn (Sorghum bicolor L. (Moench) and cowpea Vignaunguiculata). Master Thesis, College of Agriculture/ University of Basra.
4. Al-Rawi, Khasha'a Mahmoud and Abdel-Aziz Khalafallah (1980). Design and analysis of agricultural experiments. Dar Al-Kutub for printing and publishing. Mosul University, Ministry of Higher Education and Scientific Research, Iraq.
5. Abu Dahi, Youssef Mohamed and Moayad Ahmed El-Younes. (1988). Plant Nutrition Guide. Baghdad University, Ministry of Higher Education and Scientific Research, Iraq.Pg.372.
6. Al-Moazani, Saad Jaber Ghand, and Khaled Ibrahim Hashim Al-Taie. (2014). Effect of genotype and cutting stage on yield and forage quality of sorghum crop. Iraqi Journal of Agricultural Sciences, 45(6): 537-546.
7. Al-Aboudi, Safa Bahjat Abdel-Hassan and Sondos Abdel-Karim Al-Abdullah. (2022). The role of level and fractionation of nitrogen fertilizer application in N, P, K concentration, forage yield and quality for Sorghum vulgare var. Sudanense. Syrian Journal of Agricultural Research, 9(5): 317-331.
8. A.O.A.C.(1975).Association of Official Analytical Chemists. Official Members of Analysis A.O.A.C., 10Thud Republish by A.O.A.C. Washington D.C.U.S.A.
9. Amandeep, T. U., & Chaudhary, D. P. (2010). Forage quality of sorghum as influenced by irrigation, nitrogen levels and harvesting stage. Forage Research, 36: 111-114.
10. Aragaw, K.S. ; H.T. Abush ; S.A. Gedamu and T.H. Shibeshi (2020).Identification of best split application frequency and timing of nitrogen fertilizer for sorghum, (Sorghum bicolor)in Eastern Amhara.Journal of Environment and Earth Science, 10(6):25-29.
11. Granados-Niño, J. A., Reta-Sánchez, D. G., Santana, O. I., Reyes-González, A., Ochoa-Martinez, E., Díaz, F., & Sánchez-Duarte, J. I. (2021). Effect of the cutting height of sorghum at harvest on forage yield and nutritional value of silage. Revista mexicana de ciencias pecuarias, 12(3): 958-968.
12. Fageria, N. K., & Baligar, V. C. (2005). Enhancing nitrogen use efficiency in crop plants. Advances in agronomy, 88, 97-185.
13. Mengel, K., & Kirkby, E. A. (1982). Principles of Plant Nutrition 3rd edition International Potash Institute. Warblaufen-Bern Switzerland.
14. Peter, L.P. and V.R. Young . (1980). Nutriti -onal Evaluation of Protein Foods. The United Nations University, Japan. P 8

Journal Zone Publishing, Ilford, United Kingdom

15. Tena, W., & Beyene, S. (2011). Identification of growth limiting nutrient (s) in Alfisols: soil physico-chemical properties, nutrient concentrations and biomass yield of maize. Abuo-Amer ican journal of plant nutrition and fertilization technology, 1(1): 23-35.
16. Szymańska, G., Sulewska, H., Faligowska, A., & Ratajczak, K. (2018). EVALUATION OF NUTRITIVE VALUE AND QUALITY OF MAIZE (ZEA MAYS L.) SILAGE DEPENDING ON CUTTING HEIGHT AND ENSILING ADDITIVE. Fragmenta Agronomica, 35(1): 94-105.
17. Zand, N., Shakiba, M. R., Vahed, M. M., & Nasab, A. D. M. (2014). Response of sorghum to nitrogen fertilizer at different plant densities. International Journal of Farming and Allied Sciences, 3(1): 71-74.
18. Ziki, S.J.L. ; E.M.I. Zeidan ; A.Y.A. El-Banna and A.E.A. Omar (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.Research Article. 9p.

Journal Zone Publishing, Ilford, United Kingdom