

The effect of levels of nitrogen fertilization and cutting height on the growth characteristics and yield of green and dry forage of white corn (*Sorghum bicolor* L.)

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Abstract: A field experiment was conducted in the field of the College of agriculture, University of Basrah·lkarma Location (30.57 north latitude and 47.80 west longitude). The field experiment Carried out in spring agricultural Season (2021_2022). The aim of the study was to estimate the effects of five different levels of nitrogen fertilizer (0,150, 200, 250, 300) kg N ha⁻¹ in Silt loam Soils and at three different levels of cutting heights (10,20,30) cm on the growth and Forage yield of *Sorghum bicolor* L. which was planted on 1/4/2022. The experiment was applied, according to factorial experiments using randomized Complete block (R.C.B.D) with three replications. The replications were distributed randomly in each section. Three plant cuts were taken from the harvest. The following three traits were studied: Plant height, number of tillers, and Forage yield. The results showed 250 kg N ha⁻¹ has excelled, recording the highest average of plant height (168.70, 136.13, 112.97) cm, and the highest average for the number of tillers (4.10, 2.79, 2.36) tiller plant⁻¹, and also has achieved the highest average for green Forage yield (39.35, 33.91, 22.83) t ha⁻¹, and for dry Forage yield (10.21, 9.73, 6.44) t ha⁻¹ For the first, Second, third plant cuts respectively. The results have also shown that cutting height effects were significant in Most of the following traits: growth, food yield, genotype of different plant cuts. The cutting height of (10 cm) has achieved the highest average for the number of tillers (3.46, 2.13 , 2.06) tiller plant⁻¹, and the highest green Forage Yield (32. 20, 27. 26, 18. 71) t ha⁻¹, and for dry Forage yield (8. 11, 7.74, 5.07) t ha⁻¹ that for the first, Second and third plant cuts respectively. The effects of interaction between nitrogen fertilizers and cutting heights were significant in most traits of growth, dry and green Forage yield which recorded coefficient of interference equals(250 kg N ha⁻¹) with cutting height of (10 cm) , The highest average for the number of tillers (4.27, 3.05, 2.65) tiller plant⁻¹, and the highest average for green Forage yield (43.47, 39.07, 25.87) t ha⁻¹, and for dry Forage yield (11.25, 11.30, 7.16) t ha⁻¹ For the first, second, and third plant cuts respectively.

Keywords: Harvest, nitrogen fertilizer, cutting heights

Introduction

The white corn plant *Sorghum bicolor* L. belonging to the Poaceae family it is one of economic corps in the world. As well as, the importance of *Sorghum bicolor* comes in fifth place in the world after wheat, barely, rice and the yellow corn. However it is concerded Forage corps or concentrated Forage and green Forage which is used as food for animals. as well, it is impossible to make silage and thresher from it, and because lack of green Forages plant, especially in summer season which is required to increased and extension to cultivate green Forage in the summer, like white corn. And the expansion of planted these corps in summer will revive the livestock in the southern region in Iraq. It's ability to be growth and branch after the plant cuts with the reservation of good Forage that is made the plant green which is provide the number of the tillers during the summer season, which it's characterized the plant with clear lack of green Forage, and that's make the plant one of the important summer forage Forage. Like (Parkash et al in 2010 and Al-sadoon 2011, Addaher). One of the agricultural mothed that is lead to increase the production green Forage, it is the interest of fertilization and especially with nitrogen fertilizer, because of the important role to increasing the cell devisions of the plant which is reflected that positively on the heights of the plant and the number of the tillers, which is leads to increase the size of vegatative and the roots system of the plant, which is effect positively on the Forage yield like (Hermerly , 2016) . And another important agricultural process that it's had significant effect in the growth of Forage corps, that determine the height of agricultural distance or

number of the tillers. Which is effect the sufficient survival of the plant , which is enable the plant to regain growth after cutting by the tillers and the possibility of continuing for long period .In addition to that , the impact on the growth of the tillers , also the exposure of coronary and buds and the extent of exposure on these buds and the number of the tillers for drought or heat after the Forage of the tillers , which is all of this will effect positively or negatively on the quantity and quality of Forage yield (Kharbit and Hashem 2017) . For the importance of the foregoing and for the purpose of increasing the production of green fodder crops for the white corn crop, this experiment was carried out, which aims to know the response of white corn to nitrogen addition and the extent of the effect of cutting height and the interaction between them in increasing growth characteristics and forage yield.

Materials and Methods

Afield experiment was conducted in the field of college of agriculture, University of Basrah, Alkarma location(°30.57 north latitude and 80.°47 west longitude). The field experiment carried out in spring agricultural season (2021-2022). The aim of the study is to estimate the effects of five different levels of nitrogen fertilizer and three levels of agricultural distance on the growth and forage yield of Sorghum Bicolor in Silt loam Soils as described in table (1). Field experiment included two factors , Factor one is five different levels of nitrogen fertilizer (0,150, 200, 250, 300) Kg N ha⁻¹ which they were symbolized (N₀,N₁,N₂,N₃,N₄) respectively. The source of nitrogen fertilizer was "Urea" which contains (46%) nitrogen, the fertilizer was added in the form of Urea at three different batches. The first batch after a week of planting, the second batch after the first plant cut, the third batch after the second plant cut. The second factor is three different levels of agricultural distances (10,20,30)cm which they were symbolized (C₁,C₂,C₃) respectively. The field experiment was applied according to factorial experiment by using randomized complete block (R.C.B.D) three replication. The replications distributed randomly in each section (Alrawi and Khalaf Alla 1980). The soil was split into plots, according to the design with a square of (2m × 3m =6 m² for each plot and each plot contains 4 rows. The distance between the rows 50cm and The varieties were sub plots. The distance between each sub plot is 20 Cm(Abdulla et al, 2021). The seeds of white corn were planted on 1/4/2022, three plant cuts were taken from crops, the plant height were taken (cm) and the number of tillers (tiller plant⁻¹) as an average of 10 plants which were taken randomly from the two middle rows, dry and green forage yield(t ha⁻¹) for three plant cuts with cutting the two middle rows with a square of (3m²).

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

Results and Discussion

1_plant height (cm)

The result of table (2) showed N₃ fertilizer level achieved the heighst average plant height (168.70 , 136.13 , 112.97) cm for the first, second, third plant cuts respectively. it did not differ significantly from N₂ in the second plant cut which were recorded (134.67) cm . as for the third plant cut, did not differ significantly from N₂ , N₄ which were given(111.52 , 110.66) cm. And the comparison which were recorded the lowest

average for plant height (120.80, 106.57, 91.48) cm for the three plant cuts respectively. The increased in plant height resulted from the increase in the activity of Amino Acid such as Tryptophan, which is resulted from Meristematic cells which is activated when when nitrogen concentration is increased, Which built Auxins their contribute in cell division and expansion(Al-farjaw et al, 2014 and Sher et al, 2016) .

Table 2 results show the effect of cutting height is significant only in the second plant cut. It has recorded a cutting height C₃ level heigher average(132.87)cm as for C₂ cutting height, It has recorded lowest average of (121.77)cm, The reason os that when we cut pant from the top, the pant regrow from the top which were cut in opposition to the lowest height were buds grow from the ground soil. In addition to top cut helps some leaves stay in the plant, Which were considered Carbohydrates store which helps plants to grow quickly in opposition to lowest height which takes time informing leaves and it's regrowth(Imoro et al, 2021).

The effects of interaction between the cutting height and fertilizers level were significat only in the second plant cut, it was recorded N₃C₃ highest average of plant height (142.47) cm, which in trun differed significantly from the rest. Meanwhile N₀C₂ has recorded the lowest average of only (102.80)cm.

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

Cutting Height mean	Nitrogen Fertilization (Kg N ha ⁻¹)					Cutting Height	Cuttings
	N ₄	N ₃	N ₂	N ₁	N ₀		
149.97	153.20	170.47	161.47	145.20	119.50	C ₁	First
147.98	151.33	162.73	165.20	141.73	118.90	C ₂	
150.68	151.97	172.90	161.63	142.90	124.00	C ₃	
	152.17	168.70	162.77	143.28	120.80	Fertilizati on mean	
For interaction N.S	For Fertilization 4.020			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		
129.07	130.53	139.27	137.30	133.87	104.37	C ₁	Second
121.77	126.77	126.67	127.63	124.97	102.80	C ₂	
132.87	133.40	142.47	139.07	136.90	112.53	C ₃	
	130.23	136.13	134.67	131.91	106.57	Fertilizati on mean	
For interaction 3.206	For Fertilization 1.851			For Cutting Height 1.434		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		
105.35	109.70	110.43	113.80	102.27	90.53	C ₁	Third
104.39	111.93	113.13	107.43	96.27	93.20	C ₂	
107.23	110.33	115.33	113.33	106.43	90.70	C ₃	

	110.66	112.97	111.52	101.66	91.48	Fertilizati on mean
For interaction N.S	For Fertilization 4.415		For Cutting Height N.S		0.05 LSD	

2_ The number of the tillers(tiller plant⁻¹).

Table (3) results show The Excellence of N₃ trait, which werw recorded the heighest averages for the number of tillers (4. 10 , 2.79, 2.36) tiller plant⁻¹ for the first , second and third cuts respectively. Which significantly differ from the rest levels for the three cuts, meanwhile, which were recorded the comparison of lowest average for a trait the number of tillers(2.54, 1.24, 1.28) tiller plant⁻¹ for three cuts respectively. And the reason is that the number of tillers increases when we increase the nitrogen fertilizer level, Which led to increase of total radical size and therefore, The absorbtion of nutritional elements including nitrogen, which helps the growth of buds and increased the number of tillers in the plant (Alazarjawy and Alrifia, 2020 and Alaboody and Alabdullah, 2021).

Table (3) results show the excellence of C₁ in this trait. It has recorded the highest averages for the number of tillers (3.46, 2.13, 2.06)tiller plant⁻¹ for the first, second, third plant cuts respectively, which differed significantly from the rest of the levels. The lowest average for the number if tillers which were at C₃ (3.04, 1.67, 1.80) tiller plant⁻¹ for the first, second, third plant cuts respectively. The increase in number of tillers in the lowest height may due to the growth of tillers in the buds which grow closed to soil surface.

Table (3) Effect of nitrogen fertilization, cutting height and the interaction between them on the average number of tillers (tiller plant⁻¹)

Cutting Height mean	Nitrogen Fertilization (Kg N ha ⁻¹)					Cutting Height	Cuttings
	N ₄	N ₃	N ₂	N ₁	N ₀		
3.46	3.63	4.27	3.70	2.96	2.76	C ₁	First
3.05	2.93	3.97	3.20	2.63	2.50	C ₂	
3.04	2.97	4.04	3.07	2.77	2.37	C ₃	
	3.18	4.10	3.32	2.79	2.54	Fertilizati on mean	
For interaction N.S	For Fertilization 0.216		For Cutting Height 0.167		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		
2.13	2.47	3.05	1.93	1.73	1.46	C ₁	Second
1.87	1.80	2.72	2.07	1.57	1.20	C ₂	
1.67	1.90	2.60	1.53	1.23	1.07	C ₃	
	2.06	2.79	1.84	1.51	1.24	Fertilizati on mean	
For interaction N.S	For Fertilization 0.188		For Cutting Height 0.146		0.05 LSD		
Cutting Height	Nitrogen Fertilization (Kg N ha ⁻¹)					Cutting	Cuttings

mean	N ₄	N ₃	N ₂	N ₁	N ₀	Height	Third
2.06	2.45	2.65	2.14	1.73	1.34	C ₁	
1.82	1.88	2.24	1.94	1.74	1.31	C ₂	
1.80	1.98	2.18	2.08	1.58	1.18	C ₃	
	2.10	2.36	2.05	1.68	1.28	Fertilizati on mean	
For interaction N.S	For Fertilization 0.198		For Cutting Height 0.153			0.05 LSD	

3- Green Forage Yield (T Ha⁻¹)

Table(4) Shows (254)kg N ha⁻¹ has excelled in this trait it has achieved the highest average in total green forage (39.35, 33.91, 22.83) t ha⁻¹ that for the first second third plant cuts respectively. It has differed significantly from the other levels. The Comparison treatment has recorded the lowest average for green forage (13.17, 9.69, 5.12)t ha⁻¹ for the first, second third plant cuts respectively .The reason is that the increase in total green forage is the result of increasing nitrogen level and its role in the increase in plant height Table (2) and number of tillers Table (3) is the plants which is considered the Main ingredient of the green forage and its collective traits, which increase Photosynthesis Process by means of interrupt the high amount of sun rays. This result is in accordance with (Ziki et al, 2019)

As for the effect of cutting height, the results in table (4) show the excellence of (10)cm in this trait. It has recorded the highest average for green forage (32.20, 27.26, 18.71) t ha⁻¹ for the first, second and third plant cuts c respectively, which differed significantly from the other levels. Meanwhile (C₃) level has recorded the lowest average level for green forage (25.65, 22.17, 14.69) t ha⁻¹ for the first, second, third plant cuts respectively. And the increase of green forage with level (C₁)is that all the collective green forage was Cut, and the plant Started forming new branches and leaves, and There were many activities in addition to the plant's ability to regrowth and the availability of elements in the Soil Contrary to C₃ which has recorded the lowest average because of effects of Photosynthesis such as Carbohydrates, which abandons the plant. This is real attrition of the artificial elements, which were made by the plant (Kharoit and Jasime 2015 and Abood et al, 2013).

The effect of interaction between nitrogen levels and Plant height has significantly affected the result of all cuts. in N₃C₁ treatment has recorded the highest average (43.47, 39.07, 25.87) t ha⁻¹ and for all the three cuts respectively. Meanwhile N₀C₃ treatment has recorded the lowest average (11.47, 3.33) t ha⁻¹ at the first and the third plant cuts Meanwhile, the interaction treatment N₀C₂ has recorded the lowst average for second cut (8.83) t ha⁻¹.

Table (4) Effect of nitrogen fertilization, cutting height and the interaction between them on green forage yield (t ha⁻¹)

Cutting Height mean	Nitrogen Fertilization (Kg N ha ⁻¹)					Cutting Height	Cuttings
	N ₄	N ₃	N ₂	N ₁	N ₀		
32.20	34.02	43.47	41.05	26.91	15.55	C ₁	First
27.38	30.42	38.78	35.00	20.20	12.49	C ₂	
25.65	29.07	35.79	31.86	20.04	11.47	C ₃	
	31.17	39.35	35.97	22.38	13.17	Fertilizati on mean	
For interaction 1.536	For Fertilization 0.887		For Cutting Height 0.687			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		
27.26	29.37	39.07	36.20	21.30	10.37	C ₁	Second
23.58	26.73	31.93	31.47	18.93	8.83	C ₂	
22.17	23.60	30.73	28.33	18.33	9.87	C ₃	
	26.57	33.91	32.00	19.52	9.69	Fertilizati on mean	
For interaction 1.044	For Fertilization 0.602		For Cutting Height 0.467			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		
18.71	19.77	25.87	25.67	15.87	6.38	C ₁	Third
16.89	22.80	22.43	21.30	12.30	5.63	C ₂	
14.69	21.50	20.20	17.77	10.63	3.33	C ₃	
	21.36	22.83	21.58	12.93	5.12	Fertilizati on mean	
For interaction 0.993	For Fertilization 0.574		For Cutting Height 0.444			0.05 LSD	

4-Dry Forage Yield (T Ha⁻¹).

Table (5) Shows the nitrogen excelled of (250) kg N ha⁻¹ in this trait has achieved the average of highest level for dry forage reached (10.21, 9.73, 6.44) t ha⁻¹ for the first, second and third plant cuts respectively. Which has differed significantly from the other levels. The lowest average was recorded when (N₀) Compared, which resulted in (3.10, 2.56, 1.33) t ha⁻¹ for the three plant cuts respectively. Because of the increase of dry weight for the three cuts is the increase of nitrogen level, lead to the increase of green forage, which in turn has caused the increase in the dry weight forage. the increase of nitrogen level leads to absorption of Nutritional elements from soil. It reflects positively on the leaf square and leaves number and therefore, It will increase the accumulation of dry matter in the plant (Fageria, 2005 and Alaboudy and Baligar and Al-Abdulla, 2022).

As for the effect of plant height Table (5) Show and this to be very significantly high for the three plant cuts. It has recorded the highest plant (10) Cm and the highest average for dry weight of green forage (8.11, 7.74, 5.07) t ha⁻¹ for first, second and third plant cuts repectively. It has differed significantly from other levels. meanwhile, C₃ it has recorded the lowest average of plant height (6.46, 6.06, 4.12) t ha⁻¹. The reason is the increase in dry weight forage for the three Cuts at this level has excelled the total green forage for all the three cuts as it was shown in table(4), which reflects Positively in increasing of dry green forage (Gheliparkahyash et al, 2019)

The results of interaction between nitrogen level and the plant height has significantly affected the total dry forage at the second and third cuts. N₃C₁ fertilizers level has recorded the highest average (11.30 , 7.16) t ha⁻¹ for the Second and the third plant cuts respectively .meanwhile N₀C₂ has recorded the lowest average (2.36) t ha⁻¹ at the second plant cut and at the third Plant Cut, N₀C₃ interaction treatment has recorded the lowest average (0.90) t ha⁻¹

Table (5) Effect of nitrogen fertilization, cutting height and the interaction between them on average dry forage yield (t ha⁻¹)

Cutting Height mean	Nitrogen Fertilization (Kg N ha ⁻¹)					Cutting Height	Cuttings
	N ₄	N ₃	N ₂	N ₁	N ₀		
8.11	8.59	11.25	10.49	6.66	3.59	C ₁	First
6.96	7.56	10.09	8.99	5.18	3.00	C ₂	
6.46	6.97	9.31	8.28	5.02	2.71	C ₃	
	7.71	10.21	9.25	5.62	3.10	Fertilizati on mean	
For interaction N.S	For Fertilization 0.395		For Cutting Height 0.306			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		
7.74	8.10	11.30	10.46	6.01	2.81	C ₁	Second
6.44	6.72	9.19	8.77	5.14	2.36	C ₂	
6.06	6.43	8.70	7.86	4.81	2.51	C ₃	
	7.08	9.73	9.03	5.32	2.56	Fertilizati on mean	
For interaction 0.367	For Fertilization 0.212		For Cutting Height 0.164			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		
5.07	5.42	7.16	6.99	4.23	1.57	C ₁	Third
4.62	6.07	6.34	5.80	3.35	1.52	C ₂	
4.12	5.96	5.81	5.00	2.93	0.90	C ₃	
	5.82	6.44	5.93	3.50	1.33	Fertilizati on mean	
For interaction 0.315	For Fertilization 0.182		For Cutting Height 0.141			0.05 LSD	

Conclusions and recommendations.

The excellence level of 250 kg N ha⁻¹, which has recorded the highest average of plant height and th number of the tillers and the dry green forage (t ha⁻¹), as for the effect of plant height, the pant height has excelled (10)cm in i trait and the number of the tiller and the yield of dry green forage(t ha⁻¹). It has recommend to cut the white corn on the height of 10cm with addition of nitrogen fertilizer on the level of 250 kg N ha-1 to get the highest yield of green and dry forage.

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