

Effect of Nitrogen Fertilizer and Cutting Treatments on Forage and Its Components of Pearl Millet (*Pennisetum glaucum L.*) in Sulaimani Region.



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Abstract:

This investigation was conducted for two successive years (2009 and 2010) in the Qliassan Agriculture Research Station, Faculty of Agricultural Sciences University of Sulaimani, to study the effect of Nitrogen fertilizer (0 , 20 , and 40 kg N/ha) and two cutting treatment (Clipping the crop once and twice) on the characters of plant height, number of tillers/ plant, fresh and dry leaf %, fresh and dry stem %, dry matter% , green and dry weight/plant, leaf dry weight , stem dry weight, and fresh and dry forage yield for pearl millet. Results indicated the presence of significant effect of nitrogen fertilizer on dry leaf% at the first season, and on plant height and number of tillers/plant at the second season and average of both seasons, and also on characters fresh weight/plant, and dry/weight/plant dry leaf yield, forage yield at the second season and dry leaf yield and fresh forage yield only for the average of both seasons. Concerning cutting treatments on studied characters for both seasons and average of two seasons, results indicated the out-yielding the treatment of two cut in plant height, fresh and dry steam% dry steam yield fresh forage yield , dry forage yield. While the treatment of one cut out-yielded two cuts in fresh and dry leaf% in which there are no significant effect of cutting on dry matter%, dry leaf yield. Concerning to the interaction effect between the two factor levels, the results of combine analysis indicate non significant effect on all characters except of plant height, fresh weight/plant in the average of both seasons, and dry leaf yield in the second season.

Key words: *Pearl Millet, Nitrogen Fertilizer, Cutting, Forage Yield.*

Introduction:

The term 'millet' is applied to various grass crop whose seed are harvested for human food or animal feed. Compared to other cereal grains, millets are generally suited to less fertile soils and poor growing conditions, such as intense heat and low rainfall. All millets respond to nitrogen and phosphorus fertilizers. Generally 40-100 lb of nitrogen and 30-60 lb of phosphorus per acre are adequate to produce hay or seed, but most forage crops for grazing

should be fertilized more enhance forage productivity and volume. Nitrogen requirements for heavy forage production and heavy grazing will likely be doubled those required for hay and seed crops [1].

Pearl millet (*Pennisetum glaucum L.*) was domesticated as a food crop in the tropical region of West Africa at least 4000 years ago. The crop is used for variety of food products, and is even made in to a type of beer. Although pearl millet was developed as a food crop, and

is still primarily used this way in Africa and India, its grain is most likely to be used for animal feed in U.S, including poultry. According to research in Georgia pearl millet is 8 to 60% higher protein, and 40% higher in lysine than is feed corn. This higher protein and other feed characteristics have helped drive to interest in the grain by poultry producers and other livestock producers [2]. Mineral nutrition is one of the most important factors affecting plant productivity, and N is the major nutrient required by pearl millet [3].

Pearl millet has a significantly higher leaf to stem ratio than other forage such as Sudangrass, sorghum-Sudan and foxtail millets. Regrowth potential after harvesting is comparable to Sudangrass and much greater than foxtail and proso millets. Pearl millets can be grazed four to six weeks after planting. The fertilizer requirements for pearl millet are similar to other annual grass such as Oats, Foxtail millet and Sudangrass for forage production. Suggested levels would be 40-60 pounds of available nitrogen per acre, with the heavier applications in areas of goal soil moisture [4].

In the experiments to examine the effectiveness of two clipping treatments (clipping the crops once and twice) and four rates of nitrogen (0, 40, 80, and 160 Kg/ha) on green forage and dry matter yield of Barley, Oats, and triticale. Green forage and dry matter yield were significantly higher for two clippings of all three crops in both seasons, The higher rate of nitrogen fertilizer (120Kg/ha) had a major influence on green forage and dry matter and gave the highest mean for all crops [5].

Nitrogen is a building block of amino acids and protein in plants. Chlorophyll is the most abundant protein in plant. It is involved

in photosynthesis. The conversion of carbon dioxide gas and water in to sugars with the help of high energy. Chlorophyll gives plant their green color [6]. First cut yield was 3.55 tons of forage dry matter/ha. After application of 30Kg of nitrogen/ha. The millet grows for another 41 days to height of about 1 meter and was cut a second time. The second cut yield was 1.7 tons of forage dry matter/ha [7].

Cutting dates, seed rates and nitrogen rates interactions showed significant effect on forage dry matter yield. Plant height was significantly affected by cutting dates, seed rates, N levels, while effect of interaction of cutting dates X seed rates, cutting dates X nitrogen levels and seed rates X nitrogen levels were non significant. Cut, seed rate, N and (seed rate X N) significantly affected productive tillers, while rests of interactions were non-significant [8].

Plant height and dry matter percentage of both nilagrass and pangolagrass increased with cutting stage delayed. While leaf/stem ratios decreased with growth advanced. Both forage yield and quality are very important for forage production. The plant cell wall becomes more lignified with growth stage advanced. Thus the components of the plant are less digestible and the quality become poor [9].

The objectives of the present study are:

1. To determining the response of millet to nitrogen fertilization and some cutting treatments, to use it as forage crop in the region.
2. The study is to producing a cheap source of fresh forage during the fresh forage deficient period in the region.
3. In order to producing the forage with high yield and quality, the optimum cutting stage is required to be determined.

Materials and Methods

The study was conducted at Qliassan location Agriculture Research Station, Faculty of Agricultural Sciences/University of Sulaimani located (Lat 35° 34' 19", N, Long 45° 22' 1" , E, with an altitude of 765 meter above mean sea level, 2Km North west of Sulaimani City, during the summer season of 2009 and 2010 to investigate the response of pearl millet (*Pennisetum glaucum L.*) to three level (0 , 20 , 40 Kg/ha) of nitrogen fertilizer in the form of ammonium sulphate and two cutting treatments (cut 42 and 62 days after sowing).

The experiment was laid out according to randomize complete block design with four replicates, each replication contained six plots with area (3.6) m². The representative soil samples were taken from the field before tillage at (0-30) cm depth, for the first year of experiment only. Some physical and chemical properties were analyzed at the department of Soil and Water Sciences, Faculty of Agricultural Sciences, University of Sulaimani (table I).

The land of experiment was prepared by plowing the field twice and harrowed and then blocked out according to RCBD. Seed was sown at rate 3.5Kg/ha in broadcasting on May 25, 30 during the two seasons respectively. Nitrogen fertilizer distributed at one does in one cut treatment at sowing the seed, but in two cut, half of nitrogen fertilizer distributed at sowing the seed and another half nitrogen fertilizer treatment after first cutting as a second does. All plots were fertilized with 60Kg P₂O₅/ha as triple super phosphate, which was broad casted before sowing. All the standard agronomic cultural practices including irrigation, weed control uniformly

adopted for the experiment the first cut was done, when plant height was 35-40 cm, and the second cut was done after three weeks after the first cut. Cutting height is usually conducted at 7-10cm above ground level [10].

Studied characters for growth and yield components for nitrogen and cutting dates are: Growth characters: plant height (cm), number of tillers/plant, fresh and dry leaf percent, fresh and dry stem percent and plant dry matter percent (D.M%).

Yield characters (Component):-

Fresh and dry weight/plant (gm), dry leaf and stem yield (t. /ha), fresh forage and dry forage yield (t. /ha.) For recording plant height 5 plants were randomly selected in each plots, and the height was measured from the ground level to the apex of main stem, The number of tillers/plant was determined on the same five plants. Plants were hand harvested according to the designed periods (42 and 62 days). At harvest, fresh (green) forage weight was determined. The sub samples were taken (and weighted) to put it in the oven at 64 C° for 72 hours to determine dry matter percent. Another sub-samples were taken to separate leaf and stem (including the leaf sheath) [9] to determine fresh and dry leaf and stem percent. Forage dry matter yield was recorded and converted in to dry matter production by using following formula [8].

$$\text{Dry yield Kg/ha} = \frac{\text{Dry yield in cut plot}}{\text{Plot area}} * 10000$$

The data were statistically analyzed according to the methods of analysis of variance as a general test and combined analysis conducted [11]. Comparison among the means were carried out using least significant test (L.S.D) at significant level of 5% [11].

Table 1: Some physical and chemical properties of soil at Qlyassan.

Soil properties		Sampling before cultivation
P.S.D.		Silty clay
Sand (%)		7.47
Silt (%)		41.39
Clay (%)		51.14
E.C (ds.m ⁻¹)		0.49
PH		7.40
O.M. (%)		1.70
Total N (mg/g)		0.85
Available phosphate (mg/Kg ⁻¹) soil		4.76
CaCO ₃ (%)		30.13
Soluble cations & Anions m mole.L ⁻¹	Ca ⁺⁺	1.86
	Mg ⁺⁺	0.86
	K ⁺	0.17
	Na ⁺	0.54
	CO ₃ ⁻²	0.00
	HCO ₃ ⁻¹	2.86
	Cl ⁻¹	0.39
	So ₄ ⁻²	0.80

These analyses were carried out at Soil and Water Department, Faculty of Agricultural Sciences, University of Sulaimani.

Results and Discussion

Data in table (2) explain the effect of nitrogen fertilization in some growth characters for both seasons and their average. The characters dry leaf % at the first season and plant height and number of tillers/plant at the second season and the average of both seasons respond significantly to nitrogen application levels at the second season and the average of both seasons. Regarding to the first season the application of 40Kg N/ha. recorded maximum dry leaf % which was 56.375% while minimum value was 53.375%. But regarding to the second season the application of 40KgN/ha recorded maximum

plant height and number of tillers/plant which were 52.000cm and 1.850 tillers/plant respectively, while the minimum value were 37.375cm and 1.362 tillers/plant for both characters respectively produced by the treatment of control. As the average of both seasons the application of 40Kg N/ha showed maximum value due to plant height and number of tillers/plant with 55.687 cm. and 1.687 tillers/plant respectively. The treatment of control exhibited the lowest value due to these characters 46.625 cm and 1.500 tillers/plant respectively

Similar results were obtained previously by [8] indicating that nitrogen at 160kg/ha and 80Kg/ha gave plant heights of 81.9 cm and 76.2 cm respectively, and maximum productive tillers/m² 359.21 were produced by 120 Kg N/ha

while minimum productive tillers/m² 332.92 were produced by 80Kg N/ha. The increase of plant height and number of tillers/plant may be due to that the nitrogen is a building block of amino acids and protein in plants,

chlorophyll is the most abundant protein in plant. It is involved

In Photosynthesis and increasing vegetative growth[5,6]

Table 2: Effect of nitrogen fertilization in growth characters for both years and their average.

Nitrogen fertilizer levels Kg/ha	Plant height (cm)	No. of tillers/plant	Fresh leaf %	Fresh steam %	Dry leaf %	Dry stem %	Dry matter %
First year 2009							
No (0)	55.875	1.637	50.375	49.625	53.375	46.625	17.925
N1 (20)	54.125	1.512	52.375	47.625	55.500	44.500	17.775
N2 (40)	59.375	1.537	52.500	47.500	56.375	43.125	17.437
L.S.D	N.S	N.S	N.S	N.S	2.843	N.S	N.S
Second year 2010							
No (0)	37.375	1.362	47.375	52.685	49.375	51.875	21.117
N1 (20)	42.875	1.475	48.125	51.875	50.250	49.750	19.132
N2 (40)	52.000	1.850	48.750	51.250	51.000	49.000	19.557
L.S.D	6.230	0.197	N.S	N.S	N.S	N.S	N.S
Average of both years							
No (0)	46.625	1.500	48.875	51.125	51.375	49.250	19.521
N1 (20)	48.500	1.493	50.250	49.750	52.875	47.125	18.453
N2 (40)	55.687	1.687	50.625	49.375	53.937	46.062	18.497
L.S.D	4.298	0.192	N.S	N.S	N.S	N.S	N.S

Data in table (3) confirm significant effect of nitrogen fertilization in the characters fresh weight/plant, dry weight/plant dry leaf yield, and fresh forage yield at the second season while the application of nitrogen levels affected significantly in the characters dry leaf yield and fresh forage yield only for the average of both seasons. Regarding to the second season the application of 40 Kg N/ha. exceeded other levels significantly for the characters fresh weight/plant, dry weight/plant, dry leaf yield, and fresh forage

yield with 19.262 gm, 3.718 gm, 0.741 t/ha and 7.259 t/ha. respectively, while the treatment of control gave minimum value for these characters with 7.100 gm., 1.526 gm 0.532 t/ha., and 5.646 t/ha. Respectively, Regarding to the average of both years the application of 40 Kg N/ha showed maximum value for the characters dry leaf yield and fresh forage yield in which respond significantly to nitrogen fertilizer with 0.947 t/ha. And 9.470 t/ha. Respectively. While the treatment of control produced the lowest value for both characters with 0.713 t/ha and 7.489 t/ha respectively [5,8] reported similar results.

Table 3: Effect of nitrogen fertilization in yield characters for both years and their average.

Nitrogen fertilizer level Kg/ha	Forage weight/plant (gm)	Dry weight/plant (gm)	Dry leaf yield t/ha	Dry stems yield t./ha	Fresh forage yield t./ha	Dry forage yield t./ha
First year 2009						
No (0)	16.312	2.853	0.894	0.776	9.331	1.670
N1 (20)	13.687	2.260	1.041	0.824	10.787	1.866
N2 (40)	14.187	2.458	1.152	0.880	11.681	2.033
L.S.D	N.S	N.S	N.S	N.S	N.S	N.S
Second year 2010						
No (0)	7.100	1.526	0.532	0.679	5.646	1.211
N1 (20)	12.500	2.402	0.579	0.669	6.601	1.486
N2 (40)	19.262	3.718	0.741	0.714	7.259	1.455
L.S.D	8.382	1.607	0.119	N.S	1.041	N.S
Average of both years						
No (0)	11.706	2.190	0.713	0.727	7.489	1.441
N1 (20)	13.093	2.331	0.810	0.747	8.694	1.557
N2 (40)	16.725	3.088	0.947	0.797	9.470	1.744
L.S.D	N.S	N.S	0.103	N.S	1.496	N.S

Data represented in table (4) explain the effect of cutting treatments in growth characters for both seasons and their average. The second cutting treatment predominated the first cut significantly for all characters with the exception of number of tillers/plant and fresh leaf percent in the first season while at the second season the second cut also exceeded the first one significantly for all characters with the exception number of tillers/plant and dry matters percent. Regarding to the average of both seasons.

The second cut also out yield the first one significantly for all characters with the exception dry matter percent only with 54.458 cm, 1.620, 41.791%, 58.208%, 44.750% and 55.666% for the characters plant height, number of tillers/plant, fresh leaf percent, fresh stem percent, fresh leaf and dry stem percent respectively. The results of fresh and dry stem percent gave maximum values, with cutting stage delayed. These results were in agreement with the results of [9].

Table 4: Effect of cutting treatments in growth characters for both seasons and their average.

Cutting treatments	Plant height cm	No. of tillers/plant	Fresh leaf %	Fresh stem %	Dry leaf %	Dry stem %	Dry matter %
First year 2009							
First cut	52.083	1.450	54.833	45.166	57.500	42.500	18.391
Second cut	60.833	1.675	48.666	51.333	53.000	47.500	17.033
L.S.D	2.969	N.S	N.S	2.047	2.561	2.561	0.976
Second year 2010							
First cut	40.083	1.558	61.250	38.750	63.916	36.083	19.440
Second cut	48.083	1,566	34.916	65.083	36.500	64.333	20.430
L.S.D	5.756	N.S	5.088	5.069	6.640	7.479	N.S
Average of both years							
First cut	46.683	1.504	58.041	41.958	60.708	39.291	18.916
Second cut	54.458	1.620	41.791	58.208	44.750	55.666	18.732
L.S.D	5.483	0.106	2.547	0.632	3.305	3.671	N.S

Data in table (5) confirm the out-yielding the second cut for all characters due to forage and dry yield and its components with the exception dry leaf yield in the first season, and the characters fresh and dry weight/plant at the second season, and dry leaf yield for the average of both season which were found to be non significant. As the average of both seasons, the second cut recorded 15.871 gm,

2,925 gm, 0.952 t/ha, 9.519 t/ha, 1.746 t/ha, for the characters fresh weight/plant, dry weight/plant, dry stem yield fresh, forage yield, dry forage yield respectively.

These results agreed with the results of [9,8], who found highly significant differences in plant height. both fresh and dry weights with cutting at later stages.

Table 5: Effect of cutting treatments on forage and dry yield and their components for both seasons and their average.

Cutting treatments	Fresh weight/plant gm	Dry weight/plant gm	Dry leaf yield t/ha	Dry stem yield t./ha	Fresh forage yield t./ha	Dry forage yield t./ha
First year 2009						
First cut	10.375	1.794	0.998	0.734	9.533	1.733
Second cut	19.083	3.254	1.060	0.920	11.666	1.980
L.S.D	2.580	0.755	N.S	0.131	1.292	0.235
Second year 2010						
First cut	13.208	2.501	0.673	0.389	5.630	1.098
Second cut	12.700	2.596	0.526	0.985	7.372	1.511
L.S.D	N.S	N.S	0.138	0.274	1.685	0.361
Average of both years						
First cut	11.791	2.147	0.853	0.562	7.583	1.415
Second cut	15.871	2.925	0.793	0.952	9.519	1.746
L.S.D	1.926	0.405	N.S	0.141	1.178	0.200

The interaction effect between nitrogen fertilizer and cutting treatments for both seasons and their average due to growth characters represent in table (6), indicating to significant effect for only plant height as the

average of both seasons. The interaction 40Kg N/ha with the second cut gave maximum plant height 57.625 cm. while the interaction between zero Kg nitrogen/ha and the first cut recorded minimum plant height with 40.000cm

Table 6: Effect of interaction between nitrogen levels and cutting on growth characters for both seasons and their average.

Cutting treatment		Plant height cm	No. of tillers/plant	Fresh leaf %	Fresh stem %	Dry leaf %	Dry stem %	Dry matter %
Nitrogen levels								
First year								
N0(0)	First cut	49.000	1.500	53.000	47.000	56.750	43.250	18.775
	Second cut	62.750	1.775	47.750	52.250	50.000	50.000	17.075
N1(20)	First cut	51.500	1.400	54.750	45.250	56.250	43.750	18.700
	Second cut	56.750	1.625	50.000	50.000	54.750	45.250	16.850
N2(40)	First cut	55.750	1.450	56.750	43.250	59.500	40.500	17.700
	Second cut	63.000	1.625	48.250	51.250	54.250	45.750	17.175
L.S.D		N.S	N.S	N.S	N.S	N.S	N.S	N.S
Second year								
N0(0)	First cut	31.000	1.400	60.500	39.500	58.000	42.000	20.177
	Second cut	43.750	1.325	34.250	65.750	40.750	61.750	21.257
N1(20)	First cut	37.500	1.525	62.250	37.750	66.500	33.500	18.097
	Second cut	48.250	1.425	34.000	66.000	34.000	66.000	20.167
N2(40)	First cut	51.750	1.750	61.000	39.000	67.250	32.750	19.247
	Second cut	52.250	1.950	36.500	63.500	34.750	65.250	19.867
L.S.D		N.S	N.S	N.S	N.S	N.S	N.S	N.S
Average of both years								
N0(0)	First cut	40.000	1.450	56.750	43.250	57.375	55.750	19.876
	Second cut	53.250	1.550	41.000	59.000	45.375	49.375	19.166
N1(20)	First cut	44.500	1.462	58.500	41.500	61.375	56.000	18.398
	Second cut	52.500	1.525	42.000	58.000	44.375	47.000	18.508
N2(40)	First cut	55.000	1.600	58.875	41.125	63.375	57.375	18.473
	Second cut	57.625	1.787	42.375	57.625	44.500	46.125	18.521
L.S.D		4.233	N.S	N.S	N.S	N.S	N.S	N.S

Data in table (7) confirm the significant interaction between nitrogen fertilization and cutting treatments due to the characters fresh weight/plant at the first season and the average of both seasons, and dry leaf yield at the second season. The interaction between zero nitrogen/ha with the second cut gave maximum

plant weight at the first season with 23.000gm while the interaction 40Kg N/ha with the second cut for average of both seasons recording 17.375 gm. Maximum dry leaf yield produced by the interaction 40Kg N/ha with the first cut recording 0.960 t/ha. at the second season

Table 7: Effect of interaction between nitrogen levels and cutting treatments on forage and dry yield and their components for both seasons and their average.

Cutting treatment		Fresh weight/ plant gm	Dry weight/ Plant gm	Dry leaf yield t/ha	Dry stem yield t/ha	Fresh forage yield t/ha	Dry forage yield t/ha
Nitrogen levels							
First season							
N0(0)	First cut	9.625	1.797	0.909	0.692	8.496	1.601
	Second cut	23.000	3.910	0.879	0.860	10.166	1.739
N1(20)	First cut	11.125	1.767	1.017	0.785	9.908	1.802
	Second cut	16.250	2.752	1.065	0.864	11.666	1.929
N2(40)	First cut	10.375	1.817	1.069	0.725	10.196	1.795
	Second cut	18.000	3.100	1.236	1.035	13.166	2.271
L.S.D		4.469	N.S	N.S	N.S	N.S	N.S
Second season							
N0(0)	First cut	5.675	1.190	0.487	0.351	4.013	0.838
	Second cut	8.252	1.862	0.577	1.007	7.280	1.585
N1(20)	First cut	12.175	2.217	0.679	0.350	5.840	1.029
	Second cut	12.825	2.587	0.478	0.988	7.362	1.467
N2(40)	First cut	21.775	4.097	0.960	0.467	7.043	1.427
	Second cut	16.750	3.340	0.522	0.960	7.475	1.488
L.S.D		N.S	N.S	0.240	N.S	N.S	N.S
Average of both seasons							
N0(0)	First cut	7.650	1.493	0.698	0.521	6.255	1.220
	Second cut	15.762	2.886	0.728	0.934	8.723	1.662
N1(20)	First cut	11.650	1.992	0.848	0.567	7.874	1.416
	Second cut	14.573	2.670	0.771	0.926	9.514	1.698
N2(40)	First cut	16.075	2.957	1.014	0.596	8.619	1.611
	Second cut	17.375	3.220	0.879	0.998	10.320	1.877
L.S.D		3.336	N.S	N.S	N.S	N.S	N.S

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