



Effect of Nitrogen and Phosphorus Levels on Yield of Marvel Grass (*Dichanthium-Annulatum* L) in Irrigated Condition Under N-W Agro Climatic Zone



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ABSTRACT

The experiment was undertaken during *Kharif* season of 2019, 2020 and 2021 at Regional Research Station, S. D. Agricultural University, Kothara (Gujarat). The treatments comprised of three levels of nitrogen (N1: 10 kg N/ha, N2: 20 kg N/ha and N3: 30 kg N/ha) and three levels of phosphorus (P1: 0, P2: 20, P3: 40 kg P₂O₅/ha) was laid out in a factorial randomized block design with three replications. Effect of different nitrogen levels on Marvel green forage yield was found significant in pooled analysis. Application of 30 kg nitrogen/ha (N₃) recorded significantly the highest plant height (135.68 cm), effective tillers/tussock (47.44), green and dry forage yield @ 811.18 and 347.87 q/ha, Crude fibre content (38.36 %) and Crude protein content (5.21 %), while application of phosphorus has no impact significantly on yield of marvel grass in pooled as well as individual year of analysis.

Keywords: Marvel grass, Green and Dry fodder, Crude fiber, Crude protein, Nitrogen

1 Introduction

Marvel grass (*Dichanthium annulatum* (Forssk.) Stapf) is a highly valuable and important forage grass in India and Afrika [1]. It is one of the popular pasture grasses in many areas. It can be used in fields for grazing livestock and cut for hay and silage. It grows well in the areas of 350 to 2000 mm rainfall of arid regions with good sunlight. It can grow with wide range of soil, but well drained black clay soil is most suitable. It can tolerate a fair degree of drought as well as salinity but does not thrive on acidic soils. It spread over an area of about 436,000 km², including northern parts of Delhi, Aravalli ranges, parts of Punjab, almost whole of Rajasthan, Gujarat and southern Uttar Pradesh [2]. Kachchh, the largest and the western most district of Gujarat state has a very difficult terrain, recurring drought, periodic seismicity, vast areas under salt marshes (ranns), undulating rocky terrain, shallow soil, high exploitation of potable ground water. Farmers in Kachchh have reared large number of herd of animals for their subsistence, which adds to the pressure on land and fodder resources. The appropriate quantity and time of application of fertilizers especially nitrogen and phosphorus play an important role in the growth, development and yield of green as well as dry the forage crop.

2 Theory and Calculation

A field experiment was conducted consecutively for three years in *kharif* season of 2019, 2020 and 2021 at Regional Research Station, S. D. Agricultural University, Kothara on the fixed plot to study the effect of nitrogen and phosphorus levels on yield of marvel grass (*Dichanthium Annulatum* L.) in irrigated condition. The texture of the soil was loamy sand. The soil of the experimental field was low in available N



(178.0 kg/ha), medium in available P₂O₅ (76.63 kg/ ha) and available K₂O (425.38 kg/ha) and normal in soil reaction (pH 8.74) and electrical conductivity (0.35 mmhos/cm). The treatments comprised of three levels of nitrogen (N1: 10 kg N/ha, N2: 20 kg N/ha and N3: 30 kg N/ha) and three levels of phosphorus (P1: 0, P2: 20, P3: 40 kg P₂O₅/ha) was laid out in a factorial randomized block design with three replications. Crude fibre content was estimated by Scharrer Reagent Method using following formula [3]

Calculation:

% Fiber = ((W2 – W3) / W1) * 100 W1 = sample weight (1g) W2 = crucible weight with fiber and ashes, after drying in an oven at 130 °C for 90 minutes W3 = crucible weight with ashes, after muffle at 550 °C for three hours.

3 Results and Discussion

3.1 Yield (q/ha)

3.1.1 Green forage yield (q/ha)

The data presented in table 1 revealed that effect of different nitrogen levels on green forage yield of Marvel grass was found significant in individual year as well as in pooled analysis. Application of 30 kg nitrogen/ha (N3) recorded significantly produced higher green forage yield i.e., 811.18 q/ha. in pooled analysis. However, it was remained at par with 20 kg nitrogen/ha (N2) in first year of analysis.

Table 1: Green forage yield (q/ha) and Dry forage yield (q/ha) as affected by nitrogen and phosphorus levels in irrigated Marvel grass

Treatment	Green forage yield (q/ha)				Dry forage yield (q/ha)			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(A) Nitrogen levels after each cutting								
N1: 10 kg N/ha	334.09	488.85	1107.45	643.46	142.44	208.38	471.35	274.06
N2: 20 kg N/ha	377.02	553.13	1184.70	704.95	159.89	240.67	505.15	301.90
N3: 30 kg N/ha	401.13	672.03	1360.38	811.18	169.22	294.55	579.83	347.87
SEm±	9.57	10.22	14.06	6.61	3.88	5.18	6.19	2.98
CD at 5%	28.68	30.65	42.16	18.81	11.62	15.53	18.56	8.49
(B) Phosphorus levels								
P1: 0 Kg P ₂ O ₅ /ha	366.43	564.29	1202.86	711.19	155.37	246.90	512.56	304.94
P2: 20 kg P ₂ O ₅ /ha	370.78	585.49	1235.86	730.71	157.66	256.69	526.07	313.47
P3: 40 kg P ₂ O ₅ /ha	375.03	564.23	1213.81	717.69	158.53	240.00	517.70	305.41
SEm±	9.57	10.22	14.06	6.61	3.88	5.18	6.19	2.98
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Interactions								
NXP	-	-	-	NS	-	-	-	NS
Y X N	-	-	-	S	-	-	-	S
Y X P	-	-	-	NS	-	-	-	NS
Y X N X P	-	-	-	NS	-	-	-	NS
CV (%)	7.74	5.37	3.46	4.77	7.40	6.27	3.58	5.04

While significantly the lowest green forage yield (643.46 q/ha) recorded under 10 kg N /ha (N1) in pooled analysis. These might be due to increasing levels of nitrogen provides sufficient nitrogen to crop that requires for proper growth and development of plant which stimulates the chlorophyll content so ultimately increase photosynthesis and biomass production will be increased. These finding is conformity with [4]-

[14]. Effect of different levels of phosphorus was found non-significant on green forage yield of Marvel grass in individual year as well as in pooled result too. Interaction effect was found non-significant in individual years as well as in pooled analysis on green forage yield of Marvel grass.

3.1.2 Dry forage yield (q/ha)

The data presented in table 1 revealed that effect of different nitrogen levels on dry forage yield of Marvel grass was found significant in pooled analysis. Application of 30 kg N /ha (N3) recorded significantly higher dry forage yield i.e., 347.87 q/ha in pooled analysis.as well as in second and third year of analysis. However, it was remained at par with 20 kg nitrogen/ha (N2) in first year of analysis. While the lowest dry forage yield i.e., 274.06 q/ha was recorded under 10 kg N /ha (N1) in pooled analysis. Effect of different levels of phosphorus was found non-significant on dry forage yield of Marvel grass in individual year as well as in pooled result analysis. Interaction effect found non-significant in individual years as well as in pooled analysis. [6]-[8], [10]-[11],[15]-[17].

Table 2: Plant population at harvest /ha ('000) as affected by nitrogen and phosphorus levels in irrigated Marvel grass

Treatment	Plant population at harvest /ha ('000)			
	2019	2020	2021	Pooled
(A) Nitrogen levels after each cutting				
N1: 10 kg N/ha	103.22	103.22	103.22	103
N2: 20 kg N/ha	100.33	100.33	100.33	100
N3: 30 kg N/ha	102.00	102.00	102.00	102
SEm±	3.07	3.07	3.07	1.77
CD at 5%	NS	NS	NS	NS
(B) Phosphorus levels				
P1: 0 kg P ₂ O ₅ /ha	98.78	98.78	98.78	99
P2: 20 kg P ₂ O ₅ /ha	102.67	102.67	102.67	103
P3: 40 kg P ₂ O ₅ /ha	104.11	104.11	104.11	104
SEm±	3.07	3.07	3.07	1.77
CD at 5%	NS	NS	NS	NS
Interactions				
NXP	-	-	-	NS
Y X N	-	-	-	NS
Y X P	-	-	-	NS
Y X N X P	-	-	-	NS
CV (%)	9.05	9.05	9.05	9.05

3.2 Yield Attributes

3.2.1 Plant population

The data presented in table 2 indicated that effect of different nitrogen levels on marvel grasses was found non-significant on plant population. Effect of different levels of phosphorus has no significant effect on plant population. (Table 2). Interaction effect found non-significant in pooled analysis.

3.2.2 Effective tillers / tussock

The data presented in table 3 indicated that effect of different nitrogen levels on effective tillers was found significantly in pooled analysis. Application of 30 kg nitrogen/ha (N3) recorded significantly the highest (47.44) effective tillers/tussock in pooled analysis and the lowest (37.07) was recorded under 10 kg nitrogen/ha (N1). Effect of different levels of phosphorus was recorded non-significant on effective tillers (Table 3). Interaction effect on effective tillers found non-significant in pooled analysis.[11]-[12]

Table 3: Number of tillers/tussock and plant height as affected by nitrogen and phosphorus levels in irrigated Marvel grass

Treatment	Number of tillers/tussocks				Plant height (cm)			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(A) Nitrogen levels after each cutting								
N1: 10 kg N/ha	21.00	31.33	58.89	37.07	101.82	107.99	120.33	110.05
N2: 20 kg N/ha	23.22	36.89	63.67	41.26	111.44	117.22	130.17	119.61
N3: 30 kg N/ha	26.22	42.89	73.22	47.44	124.78	132.44	149.83	135.68
SEm±	0.42	0.46	0.70	0.31	2.46	2.16	1.81	1.25
CD at 5%	1.27	1.38	2.09	0.89	7.38	6.47	5.42	3.54
(B) Phosphorus levels								
P1: 0 kg P ₂ O ₅ /ha	23.1 1	36.11	65.00	41.41	109.54	118.54	133.00	120.36
P2: 20 kg P ₂ O ₅ /ha	23.2 2	37.56	65.33	42.04	115.64	120.58	133.56	123.26
P3: 40 kg P ₂ O ₅ /ha	24.1 1	37.44	65.44	42.33	112.86	118.53	133.78	121.72
SEm±	0.42	0.46	0.70	0.31	2.46	2.16	1.81	1.25
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Interactions								
NXP	-	-	-	NS	-	-	-	NS
Y X N	-	-	-	S	-	-	-	S
Y X P	-	-	-	NS	-	-	-	NS
Y X N X P	-	-	-	NS	-	-	-	NS
CV (%)	5.40	3.72	3.21	3.87	6.55	5.43	4.07	5.32

3.2.3 Plant height (cm)

The data presented in table 3 indicated that effect of different nitrogen levels on plant height was recorded significantly in pooled analysis. Application of 30 kg nitrogen/ha (N3) recorded significantly the highest (135.68 cm) in pooled analysis and the lowest (110.05 cm) was recorded under 10 kg nitrogen/ha (N1). Effect of different levels of phosphorus was recorded non-significant in plant height of marvel grass (Table 3). Interaction effect found non-significant in pooled analysis in plant height of marvel grass (Table 3). [11]-[14],[20]

3.3 Quality Parameters

3.3.1 Crude fibre content (%)

The data presented in table 4 revealed that effect of different nitrogen levels on Crude fibre content was found significant in pooled analysis. Application of 30 kg nitrogen/ha (N3) recorded significantly higher Crude fibre content of 38.36 % in pooled analysis and it was statistically at par with 20 Kg N /ha (37.73). The data presented in table 4 revealed that significant influence of different Phosphorus levels on Crude fibre contents in pooled analysis. Application of 40 kg P₂O₅/ha (P3) recorded significantly higher Crude fibre content of 38.53 % in pooled analysis and it was statistically at par with 20 Kg P₂O₅/ha (37.81). Interaction effect of nitrogen and Phosphorus levels found non-significant on Crude fibre content in pooled analysis. [6]-[8], [11],[13],[16]-[17].

Table 4: Crude fibre content (%) and Protein content (%) as affected by nitrogen and phosphorus levels in irrigated Marvel grass

Treatment	Crude fibre content (%)				Crude Protein content (%)			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(A) Nitrogen levels after each cutting								
N1: 10 kg N/ha	37.18	36.64	37.17	37.00	4.48	4.70	4.66	4.61
N2: 20 kg N/ha	37.92	37.13	38.12	37.73	4.66	4.99	4.87	4.84
N3: 30 kg N/ha	38.42	38.24	38.40	38.36	5.18	5.27	5.19	5.21
SEm±	0.64	0.58	0.60	0.35	0.09	0.11	0.09	0.06
CD at 5%	NS	NS	NS	1.00	0.28	0.33	0.28	0.16
(B) Phosphorus levels								
P1: 0 kg P ₂ O ₅ /ha	36.63	36.60	37.00	36.74	4.57	4.93	4.80	4.77
P2: 20 kg P ₂ O ₅ /ha	37.97	37.51	37.94	37.81	4.81	5.01	4.96	4.93
P3: 40 kg P ₂ O ₅ /ha	38.92	37.91	38.74	38.53	4.93	5.01	4.96	4.97
SEm±	0.64	0.58	0.60	0.35	0.09	0.11	0.09	0.06
CD at 5%	NS	NS	NS	1.00	0.28	NS	NS	0.16
Interactions								
NXP	-	-	-	NS	-	-	-	NS
Y X N	-	-	-	S	-	-	-	NS
Y X P	-	-	-	NS	-	-	-	NS
Y X N X P	-	-	-	NS	-	-	-	NS
CV (%)	5.09	4.66	4.72	4.83	5.81	6.67	5.77	6.11

3.3.2 Crude protein content (%)

The data presented in table 4 revealed that significant influence of different nitrogen levels on Crude protein content was recorded in pooled analysis. Application of 30 kg nitrogen/ha (N3) recorded significantly higher Crude protein content of 5.21 % in 3 years as well as in a pooled analysis except in second year it was statistically at par with N2 i.e., application of 20 Kg N/ha. The data presented in table 4 revealed that significant influence of different Phosphorus levels on Crude protein content was observed in pooled analysis. Application of 40 kg P₂O₅/ha (P3) recorded significantly higher Crude protein content of 4.97 % in pooled analysis and it was statistically at par with 20 Kg P₂O₅/ha (4.93). Interaction effect of nitrogen and Phosphorus levels found non-significant on Crude protein content in pooled analysis. [6]-[8], [11],[13],[16]-[17]

4 Conclusions

Green forage as well as dry forage yield was significantly affected with application of nitrogen after each cutting. However, it is noticed that there is not any significant influence of phosphorus on yield of Marvel grass. These findings will be helpful to the farmers of dry area who are doing animal farming supplemented with marvel grass for the green as well as dry fodder using as feed to the livestock.

5 Declarations

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5.3 Competing Interests

The authors declared that no conflict of interest exist in this publication.

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