E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(4): 410-415
Received: 14-01-2024
Accepted: 19-02-2024

Nilotpal Hazarika
Department of Agronomy, Assam Agricultural University, Jorhat, Assam, India

Karuna Kanta Sharma
Retd. Chief Agronomist, Advance Centre for IFS Research, Assam Agricultural University, Jorhat, Assam, India

Bipul Deka
Professor, Department of Soil Science, Assam Agricultural University, Jorhat, Assam, India

Ghana Kanta Sarma
Subject Matter Specialist, Krishi Vigyan Kendra, Barpeta, Assam Agricultural University, Jorhat, Assam, India

Corresponding Author:
Nilotpal Hazarika
Department of Agronomy, Assam Agricultural University, Jorhat, Assam, India

Effect of irrigation regimes and nitrogen levels on nitrogen uptake and soil chemical properties after growing ryegrass

Nilotpal Hazarika, Karuna Kanta Sharma, Bipul Deka and Ghana Kanta Sarma

DOI: https://doi.org/10.33545/2618060X.2024.v7.i4f.582

Abstract
A field experiment was carried out at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat. The experiment was laid out in split-plot design with three replications. The treatments consisted of five levels of irrigation in main plot *viz*., I_0: Rainfed, I_1: Irrigation at critical growth stages, I_2: Irrigation at IW: CPE ratio of 1.0, I_3: Irrigation at IW: CPE ratio of 1.2 and I_4: Irrigation at IW: CPE ratio of 1.4 along with four levels of N - N_0: 0 kg N/ha, N_1: 30 kg N/ha, N_2: 60kg N/ha and N_3: 90 kg N/ha in sub- plots. The soil of the experimental site was sandy loam in texture, acidic in reaction, medium in organic carbon, medium in available N, available P_2O_5 and low in available K_2O. The results revealed that higher values of nitrogen uptake was found in irrigation at IW: CPE ratio of 1.4. The treatment receiving nitrogen levels 90 kg/ha recorded higher values of nitrogen uptake. The effect of irrigation regimes on available N, P_2O_5 and K_2O content in soil were found to be non-significant after harvest of ryegrass. The available N content in soil was found significant due to the effect of nitrogen levels but available P_2O_5 and K_2O content in soil were found non-significant.

Keywords: Rainfed, critical growth stage, IW: CPE, nitrogen, phosphorus, potassium

Introduction
Water and nitrogen play important role in the growth and yield of annual ryegrass. N fertilization increases the yield and quality of leaf material on grasses. Pastures can make greater use of available N with adequate soil moisture than dry conditions. As a result, different levels of soil moisture cause high fluctuations in yield and quality, especially at higher rates of N (Akmal and Janssens, 2004) [1]. Increasing level of nitrogen upto 100 kg N ha^{-1} significantly increased N uptake of maize (Majumdar *et al*., 2002) [5]. Ammaji and Suryanarayana (2003) [2] observed that increased nitrogen uptake of fodder sorghum with increment in the dose of nitrogen upto 120 kg ha^{-1}. Application of 150 kg N ha^{-1} resulted in higher total nitrogen (110.3 kg ha^{-1}), phosphorus (10.6 kg ha^{-1}) and potassium (213.2 kg ha^{-1}) uptake by oat followed 120 and 90 kg N ha^{-1} (Bhat *et al*., 2000) [3]. The maximum available soil nitrogen (280.29 kg ha^{-1}) was recorded with 110 kg N ha^{-1} which was significantly higher over 70 kg and 90 kg N ha^{-1} after harvest of fodder oat (Jat *et al*., 2018) [4].

Materials and Methods
The experiment was laid out in a split-plot design with three replications. The treatments consisted of five levels of irrigation in main plot *viz*., Rainfed, Irrigation at critical growth stages, Irrigation at IW: CPE ratio of 1.0, Irrigation at IW: CPE ratio of 1.2 and Irrigation at IW: CPE ratio of 1.4 along with four levels of N- 0 kg N/ha, 30 kg N/ha, 60kg N/ha and 90 kg N/ha in sub-plots. The nutrients were applied in the form urea, single super phosphate (SSP) and muriate of potash (MOP) as per requirement in the treatment. Nitrogen was applied in three split doses i.e. ½ of N is applied in final ploughing, ¼ at 1st cut and remaining ¼ at 2nd cut as per the treatment. All the phosphatic and potassic fertilizers were applied at the rate of 188 kg/ha of SSP and 50 kg/ha of MOP, respectively one day ahead of sowing ryegrass.

The experiment was conducted consecutively for a period of two years.

Results and Discussion

Nitrogen content and uptake

The nitrogen content (%) of ryegrass was found to be non-significant (Table 1) at all three cuts during both years due to the effect of irrigation regimes. The nitrogen uptake of ryegrass was found to be significant at all three cuts during both the years due to the effect of irrigation regimes (Table 2). The highest nitrogen uptake was obtained in irrigation at IW: CPE ratio of 1.4 being of 34.36 kg/ha, 45.33 kg/ha, 42.61 kg/ha and 34.30 kg/ha, 45.01 kg/ha, 40.15 kg/ha which was significant to other irrigation treatments at 1st cut, 2nd cut and 3rdcut, respectively during both the years. It was due to the nutrient solubilisation increased under the higher irrigation regimes which increased the availability of nutrients to the crop for better uptake. These findings were in agreement with Sonowal (2012) [6]. The effect of different nitrogen levels on nitrogen content of ryegrass was found to be significant at all three cuts during both years (Table 1). The highest nitrogen content was found under 90 kg N/ ha treatment and the lowest content was observed in 0 kg N/ha. Increase in nitrogen content may be due to higher availability of nitrogen in the soil under the treatment of 90 kg N/ha. The nitrogen uptake by ryegrass as influenced by different levels of nutrient are found to be significant at 1st cut, 2nd cut and 3rd cut during both the years (Table 2). Application of 90 kg N/ha recorded the highest nitrogen uptake being 31.72 kg/ha, 38.45 kg/ha, 35.47 kg/ha and 30.99 kg/ha, 40.79 kg/ha, 36.15 kg/ha at 1st cut, 2nd cut and 3rd cut, respectively during both the years which was significantly higher than 60 kg N/ha, 30 kg N/ha and 0 kg N/ha. The increased uptake of nitrogen might be due to high availability of nitrogen in the soil which might have helped plants can easily take nitrogen.

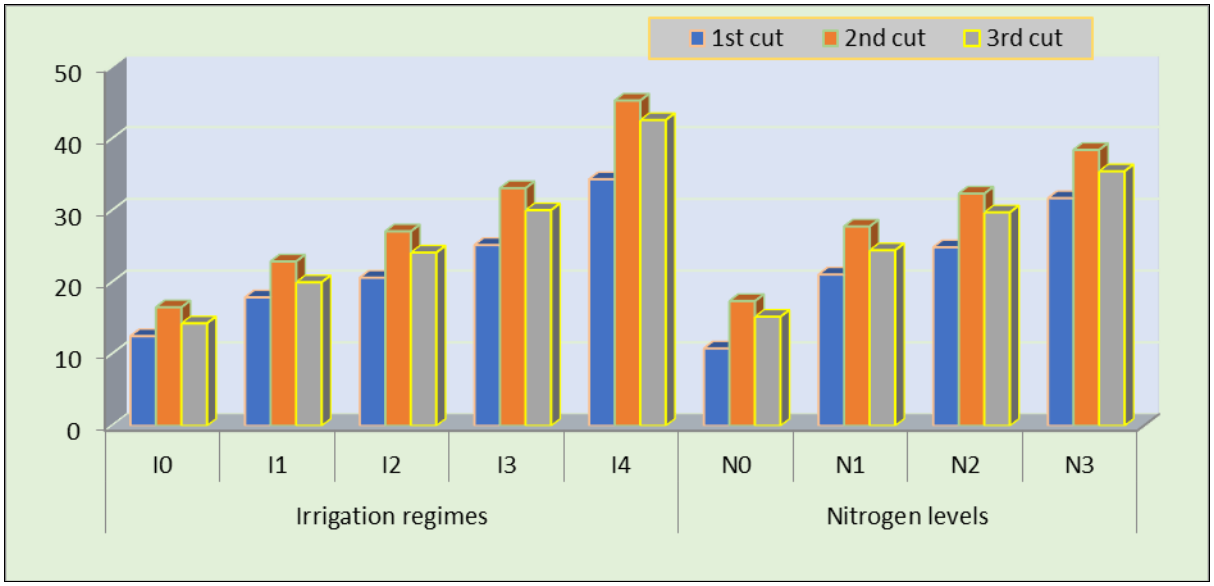
Table 1: Effect of irrigation regimes (I) and nitrogen levels (N) on nitrogen content (%) of ryegrass

Treatments	Nitrogen content (%)					
	1st Year			2nd Year		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Irrigation regimes (I)						
I_0	1.22	1.32	1.30	1.22	1.32	1.30
I_1	1.25	1.34	1.32	1.26	1.35	1.33
I_2	1.30	1.42	1.40	1.30	1.42	1.42
I_3	1.34	1.46	1.44	1.34	1.47	1.46
I_4	1.37	1.48	1.46	1.38	1.48	1.47
S.Ed (±)	0.065	0.053	0.058	0.048	0.052	0.066
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Nitrogen levels (N)						
N_0	1.24	1.35	1.32	1.22	1.34	1.29
N_1	1.28	1.37	1.35	1.27	1.37	1.37
N_2	1.30	1.42	1.40	1.31	1.43	1.42
N_3	1.36	1.47	1.47	1.37	1.49	1.50
S. Ed (±)	0.039	0.033	0.036	0.028	0.043	0.041
CD (P=0.05)	0.089	0.075	0.083	0.064	0.099	0.094
Interaction (I×N)						
S.Ed (±)	0.086	0.073	0.080	0.062	0.097	0.091
CD (P=0.05)	NS	NS	NS	NS	NS	NS

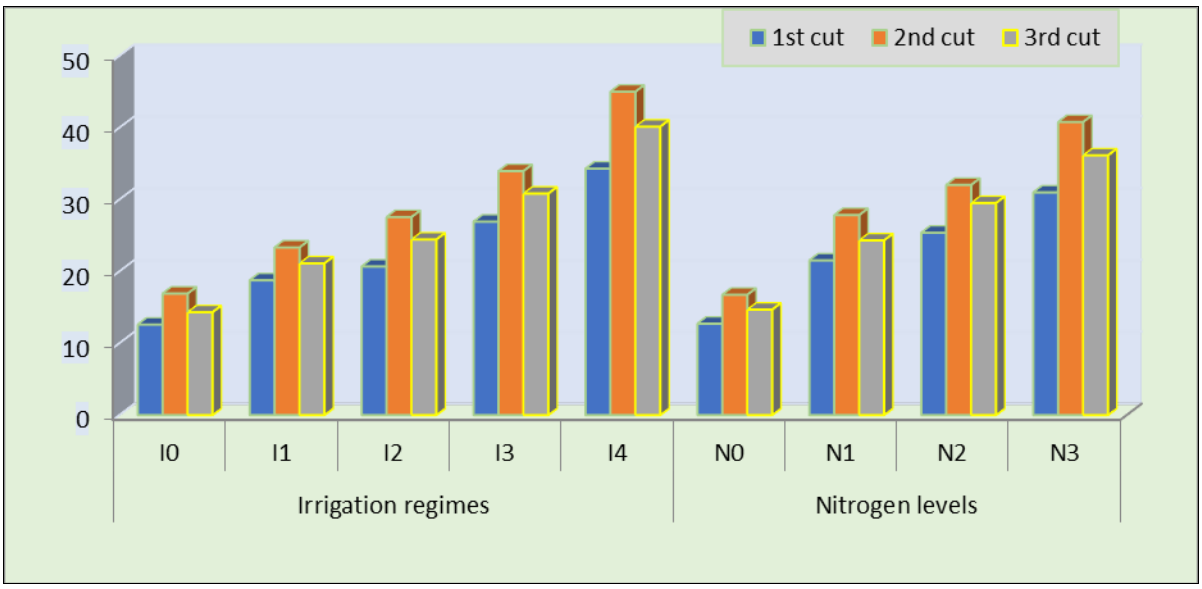
N.S: Non-significant

Table 2: Effect of irrigation regimes (I) and nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass

Treatments	Nitrogen uptake (kg/ha)					
	1st Year			2nd Year		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Irrigation regimes (I)						
I_0	12.49	16.52	14.28	12.59	16.91	14.31
I_1	17.90	22.90	20.00	18.76	23.33	21.12
I_2	20.63	27.10	24.14	20.68	27.56	24.44
I_3	25.19	33.12	30.05	26.92	33.96	30.83
I_4	34.36	45.33	42.61	34.30	45.01	40.15
S.Ed (±)	1.86	2.39	2.71	1.07	3.07	2.59
CD (P=0.05)	4.29	5.51	6.25	2.47	7.09	5.96
Nitrogen levels (N)						
N_0	10.78	17.38	15.20	12.72	16.74	14.68
N_1	21.08	27.78	24.46	21.53	27.84	24.32
N_2	24.88	32.36	29.74	25.38	32.04	29.52
N_3	31.72	38.45	35.47	30.99	40.79	36.15
S. Ed (±)	1.18	1.34	1.40	1.12	1.57	1.48
CD (P=0.05)	2.72	3.10	3.23	2.58	3.63	3.42
Interaction (I×N)						
S.Ed (±)	2.64	3.00	3.13	2.50	3.52	3.32
CD (P=0.05)	5.39	6.13	6.39	5.11	7.18	6.76



Graph 1: Indicating the effect of irrigation regimes (I) and nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass during 1st Year



Graph 2: Indicating the effect of irrigation regimes (I) and nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass during 2nd Year

Interaction

The interaction effect between irrigation regimes and nitrogen levels on nitrogen content was found to non-significant but nitrogen uptake was found to differ significant at all three cuts during both the years (Table 3, Table 4, Table 5, Table 6, Table 7 and Table 8). The application of irrigation at IW: CPE ratio of 1.4 in combination with 90 kg N/ha recorded the highest nitrogen uptake at 1st cut, 2ndcut and 3rd cut during both the years followed by irrigation at IW: CPE ratio of 1.2 in combination with 60 kg N/ha. Rainfed treatment in combination with 0 kg N/ha recorded the lowest nitrogen uptake in all three cuts during both the years. The increased uptake of nitrogen might be due to with better availability of soil moisture and high availability of nitrogen, plant could easily take nitrogen from the soil.

Table 3: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 1stcut (1st Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	6.31	8.21	9.73	10.28	19.34	10.78
N_1	11.00	16.80	19.83	24.02	33.74	21.08
N_2	14.86	19.48	21.89	29.20	39.00	24.88
N_3	17.77	27.11	31.07	37.27	45.36	31.72
Mean	12.49	17.90	20.63	25.19	34.36	22.11
		I		**N**		**I×N**
S.Ed (±)		1.86		1.18		2.64
CD (P=0.05)		4.29		2.72		5.39

Table 4: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 2nd cut (1st Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	10.46	13.24	16.51	16.96	29.75	17.38
N_1	14.50	21.69	27.83	32.85	42.04	27.78
N_2	19.36	25.50	27.87	37.74	51.35	32.36
N_3	21.76	31.18	36.18	44.95	58.17	38.45
Mean	16.52	22.90	27.10	33.12	45.33	29.00
		I		**N**		**I×N**
S.Ed (±)		2.39		1.34		3.01
CD (P=0.05)		5.51		3.10		6.13

Table 5: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 3rd cut (1st Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	8.10	11.20	14.68	14.52	27.47	15.20
N_1	12.49	19.87	22.38	29.28	38.28	24.46
N_2	17.84	22.47	25.58	33.87	48.94	29.74
N_3	18.69	26.48	33.92	42.51	55.77	35.47
Mean	14.28	20.00	24.14	30.05	42.61	26.22
		I		**N**		**I×N**
S.Ed (±)		2.71		1.40		3.131
CD (P=0.05)		6.25		3.23		6.39

Table 6: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 1st cut (2nd Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	7.34	10.57	12.04	12.79	20.83	12.72
N_1	10.98	17.17	20.61	25.26	33.60	21.53
N_2	14.98	21.10	22.13	31.58	37.09	25.38
N_3	17.04	26.20	27.95	38.06	45.68	30.99
Mean	12.59	18.76	20.68	26.92	34.30	22.65
		I		**N**		**I×N**
S.Ed (±)		1.07		1.12		2.50
CD (P=0.05)		2.47		2.58		5.11

Table 7: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 2nd cut (2nd Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	10.92	13.52	15.86	17.31	26.12	16.74
N_1	15.13	22.92	27.30	33.27	40.57	27.84
N_2	19.65	25.52	29.02	38.26	47.73	32.04
N_3	21.92	31.34	38.05	47.01	65.64	40.79
Mean	16.91	23.33	27.56	33.96	45.01	29.35
		I		**N**		**I×N**
S.Ed (±)		3.07		1.57		3.52
CD (P=0.05)		7.09		3.63		7.18

Table 8: Interaction effect of irrigation regimes (I) × nitrogen levels (N) on nitrogen uptake (kg/ha) of ryegrass at 3rd cut (2nd Year)

Nitrogen levels (N)	Irrigation regimes (I)					Mean
	I_0	I_1	I_2	I_3	I_4	
N_O	8.19	11.62	15.02	15.14	23.45	14.68
N_1	12.58	20.77	22.30	30.24	35.72	24.32
N_2	17.92	23.19	26.24	34.74	45.51	29.52
N_3	18.57	28.92	34.20	43.18	55.92	36.15
Mean	14.31	21.12	24.44	30.83	40.15	26.17
		I		**N**		**I×N**
S.Ed (±)		2.59		1.48		3.32
CD (P=0.05)		5.96		3.42		6.76

Soil pH and organic carbon of soil after harvest of ryegrass

Table 9: Effect of irrigation regimes (I) and nitrogen levels (N) on soil pH and organic carbon (%) of soil after harvest of ryegrass

Treatments	Soil pH		OC (%)	
	1st Year	2nd Year	1st Year	2nd Year
Irrigation regimes (I)				
I_0	5.54	5.52	0.684	0.677
I_1	5.55	5.51	0.682	0.678
I_2	5.54	5.53	0.678	0.671
I_3	5.57	5.50	0.688	0.686
I_4	5.56	5.53	0.687	0.678
S.Ed (±)	0.014	0.013	0.005	0.005
CD (P=0.05)	NS	NS	NS	NS
Nitrogen levels (N)				
N_0	5.55	5.52	0.685	0.678
N_1	5.54	5.53	0.681	0.677
N_2	5.55	5.50	0.682	0.675
N_3	5.56	5.52	0.687	0.681
S. Ed (±)	0.011	0.015	0.005	0.004
CD (P=0.05)	NS	NS	NS	NS
Interaction (I×N)				
S.Ed (±)	0.026	0.033	0.012	0.008
CD (P=0.05)	NS	NS	NS	NS

N.S: Non-significant

During both the years, the different irrigation regimes and nitrogen levels did not bring any significant effect on soil pH and organic carbon of soil after harvest of ryegrass (Table 9).

Available N, P_2O_5 and K_2O content in soil after harvest of ryegrass

Table 10: Effect of irrigation regimes (I) and nitrogen levels (N) on available of N, P_2O_5 and K_2O (kg/ha) of soil after harvest of ryegrass

Treatments	N (kg/ha)		P_2O_5 (kg/ha)		K_2O (kg/ha)	
	1st Year	2nd Year	1st Year	2nd Year	1st Year	2nd Year
Irrigation regimes (I)						
I_0	286.50	284.71	24.40	24.43	121.35	121.26
I_1	285.62	281.87	24.31	24.36	121.23	121.19
I_2	282.35	280.06	24.16	24.23	121.12	121.14
I_3	280.54	278.57	23.93	24.07	120.92	120.98
I_4	279.78	275.72	23.73	23.94	120.83	120.81
S.Ed (±)	2.40	2.62	0.27	0.20	0.43	0.36
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Nitrogen levels (N)						
N_0	279.04	276.79	23.90	23.96	120.93	120.97
N_1	281.46	279.30	23.96	24.12	121.00	121.02
N_2	284.24	280.81	24.21	24.30	121.12	121.13
N_3	287.09	283.86	24.36	24.45	121.30	121.20
S. Ed (±)	2.13	2.09	0.29	0.31	0.40	0.41
CD (P=0.05)	4.91	4.83	NS	NS	NS	NS
Interaction (I×N)						
S.Ed (±)	4.76	4.68	0.64	0.70	0.90	0.93
CD (P=0.05)	NS	NS	NS	NS	NS	NS

N.S: Non-significant

The effect of irrigation regimes on available N, P_2O_5 and K_2O content in soil were found to be non-significant after harvest of ryegrass during both the years (Table 10). The effect of different N levels on available soil nitrogen was found to be significant but available P_2O_5 and K_2O content in soil were found to be non-significant (Table 10). The highest available N (287.09 kg/ha and 283.86 kg/ha, respectively in both the years) in soil was found under 90 kg N/ha treatment as compared to 60 kg N/ha, 30 kg N/ha and 0 kg N/ha. Residual impact of higher dose of nitrogen increases the availability of nitrogen in the respective treatment. The interaction effect between irrigation regimes and nitrogen levels was found to be non-significant on available N, P_2O_5 and K_2O content in soil after harvest of ryegrass during both the years.

Conclusion

From the investigation it was observed that the nitrogen content of ryegrass was found to be non-significant due to the effect of irrigation regimes. The highest nitrogen uptake was obtained in irrigation at IW: CPE ratio of 1.4 compared to other irrigation treatments. The highest nitrogen content was obtained in 90 kg N/ha. Significantly higher nitrogen uptake was found in 90 kg N/ha followed by 60 kg N/ha. Soil parameters like soil pH, organic carbon, available N, P_2O_5 and K_2O content in soil after harvest of ryegrass were not significantly affected by different irrigation regimes. No significant difference was found in soil parameters like soilpH, organic carbon, available P_2O_5 and K_2O but available N was found to be significant due to the effect of nitrogen levels. The highest available N in soil was found in 90 kg N/ha treatment as compared to other nitrogen levels. Among the different treatment combination of irrigation regimes and nitrogen levels, the highest nitrogen uptake was recorded with application of irrigation at IW: CPE ratio of 1.4 in combination with 90 kg N/ha.

References

1. Akmal M, Janssens MJJ. Productivity and light use efficiency of perennial ryegrass with contrasting water and nitrogen supplies. Field Crops Research. 2004;88:143-155.
2. Ammaji P, Suryanarayana K. Yield and nutritive value of fodder sorghum varieties as influenced by different levels of nitrogen. The Andhra Agricultural Journal. 2003;50(3/4):199-202.
3. Bhat MD, Singh KN, Bali A, Shah MH. Grain yield of oat (*Avena sativa* L.) as influenced by sowing time and nitrogen levels under temperate conditions of Kashmir. Indian Journal of Agronomy. 2000;45(1):199-204.
4. Jat H, Kaushik MK, Choudhary JL, Jat H, Solanki NS, Dashora LN. Irrigation and nitrogen management in fodder oat (*Avena sativa* L.) in the agro-climatic zone IV 'a' of

Rajasthan. International Journal of Chemical Studies. 2018;6(4):749-751.
5. Majumdar B, Venkatesh MS, Kumar K, Patiram. Effect of nitrogen, sulphur and pig manure application on yield, nutrient uptake and quality parameters of maize-mustard crop rotation and residual nutrient buildup in an acidic alfisols of Meghalaya. Journal of Hill Research. 2002;15:63-70.
6. Sonowal D. Performance of toria under different levels of irrigation and potassium. An M.SC. (Agri) thesis submitted to Department of Agronomy, AAU, Jorhat; c2012.