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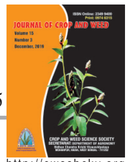

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Management of N levels and time of cut in *rabi* forage oat (*Avena sativa* L.)

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ABSTRACT

During the 2016-17 rabi season, a study on "Management of N levels and time of cut in rabi forage oat (Avena sativa L.)" was conducted at Agronomy Instructional Farm, SDAU, Sardarkrushinagar with twelve treatment combinations comprised of four N levels viz., 80 kg ha^{-1}(N_1), 100 kg ha^{-1}(N_2), 120 kg ha^{-1}(N_3) and 140 kg ha^{-1}(N_4) and three cutting management practices, 45 days after sowing (C_1), 55 days after sowing (C_2), and 65 days after sowing (C_3), were conducted in four replications of a randomised block design (factorial concept). Plant growth, yield and quality characteristics were all significantly increased when the rabi forage oat was fertilised with 140 kg nitrogen ha^{-1}. Cutting at 65 days after sowing resulted in significantly higher growth attributes and nitrogen uptake, and crude fibre content. Fertilizing rabi forage oat with 140 kg nitrogen ha^{-1}and 65 days after sowing cutting can result in higher green forage yield, net monetization and benefit cost ratio.

Keywords : Forage oat, N levels, time of cut, yield and economics

Oat (*Avena sativa* L.), often known as "Javi" or "Jayi," is a highly adapted cereal fodder crop in India (Pravallika and Gaikwad, 2021). It has a high nutritional value and a fast growth rate. It also has an outstanding regeneration capability and palatability. Oats are high in protein, carbohydrates, and fibre,with a nutritional value of 6-7 per cent protein, 66 per cent carbohydrates, and 11 per cent fibre.Oat regrowth provides green forage for cattle and plays a vital role in this process. Oats are a versatile crop that thrives in both temperate and subtropical environments. It is notably high in fat, protein, vitamin B_1, phosphorus, and iron as a high-nutritional cereal (Tiwana *et al.,* 2008).The bulk of fodder oats are field dry, with the remainder being turned into hay or silage for usage when food is scarce (Suttie and Reynolds, 2004).

Among the various fodder crops grown for animal feed, oat has proven to be the most productive and appropriate fodder crop. Because of its vast varietal diversity, oats can be grown in a wide range of climatic conditions and feeds livestock with energy-rich, nutritious, and palatable green fodder. It is also used to make hay and silage (Singh *et al*., 1973). Forage oat yield and quality are influenced by a variety of factors. Fertilization and cutting management are two major aspects that influence the productivity and quality of fodder crops (Mahale *et al.,* 2004).

Nitrogen is necessary for fodder production because it affects cell elongation, inter-nodal expansion, and cell division. It is also critical for the crop early establishment. It increases fodder yield by improving growth parameters and dry matter growth (Kumar *et al.,* 2001).

Crop yield is also affected by cutting management. It is another important factor in determining fodder quality (Bhilare and Joshi, 2007), as it has a significant impact on succulency, dry matter, crude protein, and other quality parameters.Demetrio *et al.* (2012) revealed that taking one or two cuttings during the vegetative phase resulted in a higher forage yield during the flowering phase.Sharma and Bhunia (2001) noticed an interaction effect between N level and cutting management, with higher fodder yield produced by increasing N levels and a single cut at 85 DAS.

The current research aims to identify appropriate combinations of different nitrogen levels and cutting management in *rabi* forage oat in order to sustain production under Gujarat conditions.

Field experiment was conducted during the *rabi* of 2016-17 at Agronomy Instructional Farm, SDAU, Sardarkrushinagar (Geographically, at 24^0 19' North latitude and $72^0$19' East longitude). The soil of the area is loamy sand, belonging to the taxonomical order Aridisol. The pH is 7.58 and the soil has 151.36 kg available N, 34.60 kg available P_2O_5, and 282.50 kg available K_2O ha^{-1}. After land preparation, plots of 5m length and 3m breadth were formed by bunds of 30cm width and 15cm height. Twelve treatment combinations comprised of four N levels *viz*., 80 kg N ha^{-1}(N_1), 100 kg N ha^{-1}(N_2), 120 kg N ha^{-1}(N_3) and 140 kg N ha^{-1}(N_4) and three cutting management practices, 45 days after sowing (DAS) (C_1), 55 DAS (C_2), and 65 DAS (C_3), were subjected to four replications of a randomised block design (factorial concept).

Sowing at a depth of 2-3cm of inter row spacing 30cm and lightly filling them with soil (variety Kent @ 80 kg/ ha on November 11th). Just before sowing, a ½ N (2 splits) as urea and entire P as DAP treated as a basal dose in the previously opened furrows and lightly covered with soil. At 45, 55, and 65 days after the first cut, the crop was harvested according to cutting

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treatment, and the second cut was harvested 35 days later (P_2O_5 = 60 kg/ha phosphorous was applied as a common dose; ½ of N as a basal dose, ¼ N applied 25 to 30 DAS, and the remaining ¼ N applied after first cut). To ensure good germination and plant establishment, light irrigation was applied immediately after sowing the seeds, followed by a second irrigation four days later. Irrigation was then applied in accordance with crop needs.

To keep the plots weed-free, one interculturing and two hand weeding operations were performed. The crop was harvested according to cutting treatment at 45, 55, and 65 DAS, with a second cut taken 35 days after the first cut. Plant growth, yield and quality parameters, and nutrients availability in soil.

The calculated 'F' value was calculated and compared to the table "F" value at a 5 per cent level of significance with S.Em.,C.D., C.V.%, and data were all statistically analysed by Panse and Sukhatme (1967).

Effect of nitrogen levels

Table 1 shows that increasing nitrogen levels increased plant height considerably and linearly at the first, second, and mean values of both cuttings.The treatment of 140 kg N ha^{-1} (N_4) resulted in a much taller plant in the mean values of both cuttings (87.4 cm) and it was 23.5 per cent higher than the treatment of 80 kg N ha^{-1}(N_1).This study similar studies of Bhilare and Joshi (2008) and Singh *et al.* (2012). When compared to 80 kg N ha^{-1}, Patel *et al.* (2010) found that 120 kg N ha^{-1} reflected in the largest plant height of the oat.

The usage of N_4 secured in the more number of tillers plant^{-1} (5.7) at mean values of both cuts. At mean values of both cuts, 140 kg N ha^{-1}(N_4) application resulted in 16.3 percent more tillers per plant than N_1(Table 1).This is due to a sufficient supply of available nitrogen to the crop root, which results in increased tiller shooting to the plant base.Patel *et al.* (2010) also observed that treating 120 kg N ha^{-1} to the oat resulted in a higher number of total tillers metre row length^{-1}. Similar trends was also observed by the findings of Singh *et al.* (1993), Patel and Rajgopal (2002), Bhilare and Joshi (2008), Tiwana and Puri (2004), Sharma (2009), Patel *et al.* (2010), Joshi *et al.* (2015) and Midha *et al*. (2015). Sharma and Verma (2005) observed that treating 150 kg N ha^{-1}resulted in a forage oats have a much higher number of tillers plant^{-1}.

At mean values of both cuts, N_4resulted in the largest leaf area plant^{-1} (398.1 cm^2), which was 14.5 per cent larger than N_1(Table 1). At high doses of N, the improvement in leaf area plant^{-1} resulted to a faster rate of leaf area expansion as a result of faster cell division and cell expansion, leading to higher leaf length and leaf width, leaf area plant^{-1} of forage oat and a concomitant increase in photosynthetic formation. Furthermore, the increased leaf area per plant might be attributable to the application of the correct amount of nitrogen to the forage oat. These findings were consistent with previous findings of Sharma and Bhunia (2001), Tiwana and Puri (2004), Sharma (2009), Malakar *et al.* (2009) and Jat *et al.* (2015).

N_4 had the considerably higher number of leaves plant^{-1} (42.7) at mean values of both cuts. It led in a 63.6 per cent increase in the number of leaves plant^{-1} as compared to N_1 at mean values of both cuts (Table 1). The current studyis in line results of Patel and Rajgopal (2002) and Bhilare and Joshi (2008), Ayub *et al.* (2009), Banjara and Banjara (2014). Khan *et al.* (2014) found that applying 180 kg N ha^{-1} to fodder maize plants resulted in a considerably higher number of leaves plant^{-1}.

Crop fertilized by 140 kg N ha^{-1} (N_4) registered maximum leaf: stem ratio (0.34) at mean values of both cuts and recorded 47.8 per cent higher leaf: stem ratio at mean values of both cuts than that of 80 kg N ha^{-1}(N_1) (Table 2). The enhancement in production of leaf material as compared to stem by the application of higher N.These conclusions are consistent with the previous findings of According to Sharma (2009), when the nitrogen content of fodder oats was increased to 150 kg N ha^{-1}, the leaf: stem ratio increased rapidly.

Green forage production was substantially greater and lower (507 and 324 q ha^{-1}, respectively) when 140 and 80 kg N ha^{-1} were treated to total green forage output.The per cent rise in green forage production enhanced by $N_4$was 56.5 per cent over N_1 when both cuts were combined. A favourable affect on yield indices such as plant height (Table 1), number of tillers plant^{-1} (Table 1), number of leaves plant^{-1} (Table 1), and leaf: stem ratio (Table 1) might explain the considerable increase in yields with higher nitrogen levels (Table 2). Increased photosynthetic activity and synthesis of additional photosynthates may have occurred from the increase in leafy part caused by nitrogen treatment.Growth attributes may have been improved as a result of the readily available food growing portions. As a result, nitrogen produced a better reaction on oat forage output. More or less similar response observed by Mahale *et al.* (2004), Kakol *et al.* (2003), Dudhal *et al.* (2004), Pathan *et al.* (2005), Tiwana and Puri (2005), Bhilare and Joshi (2008). According to Patel and Alagundagi (2013) the treatment of 150 kg N ha^{-1} considerably decreased the green forage production of forage oat.

At first cut, the use of N_4 produced the maximum dry matter yield (75 q ha^{-1}) and N_1 at total of both cuttings, the lower dry matter yield of forage oat was recorded (77 q ha^{-1}). At the total of both cuts, the dry matter yield was 55.8 per cent greater than the N_1 yield. According

Table 1: Plant height and growth attributes of *rabi* forage oat as influenced by nitrogen and cutting management treatments

Treatments	Plant population		Plant height (cm)			Number of tillers $plant^{-1}$			Leaf area $plant^{-1}$ (cm^2)			Number of leaves per plant		
	Initial	Final	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Nitrogen levels (N):														
N_1 : 80 kg/ha	55	52	83.8	57.8	70.8	5.0	4.7	4.9	425.4	270.2	347.8	28.3	23.8	26.1
N_2 : 100 kg/ha	56	53	97.7	62.1	79.9	5.1	4.8	5.0	433.4	271.1	352.2	36.3	31.4	33.9
N_3 : 120 kg/ha	57	55	99.3	66.4	82.9	5.3	5.0	5.1	459.7	288.6	374.2	41.1	36.7	38.9
N_4 : 140 kg/ha	60	56	102.5	72.3	87.4	5.8	5.5	5.7	488.6	307.6	398.1	45.5	39.8	42.7
SEm(±)	**1.3**	**1.3**	**2.46**	**1.60**	**1.64**	**0.17**	**0.17**	**0.14**	**9.22**	**5.89**	**5.86**	**1.03**	**1.06**	**0.85**
LSD(0.05)	**NS**	**NS**	**7.07**	**4.60**	**4.71**	**0.49**	**0.48**	**0.40**	**26.51**	**16.95**	**16.86**	**2.95**	**3.05**	**2.45**
Cutting management (C):														
C_1 : 45 DAS	56	53	89.3	59.2	74.3	5.2	4.7	5.0	428.0	260.0	344.0	33.9	30.1	32.0
C_2 : 55 DAS	57	55	95.9	67.9	81.9	5.3	5.2	5.2	451.1	305.1	378.1	38.5	34.6	36.6
C_3 : 65 DAS	58	54	102.2	66.9	84.5	5.5	5.1	5.3	476.2	288.1	382.1	41.1	34.1	37.6
SEm(±)	**1.2**	**1.1**	**2.13**	**1.39**	**1.42**	**0.15**	**0.14**	**0.12**	**7.98**	**5.10**	**5.08**	**0.89**	**0.92**	**0.74**
LSD(0.05)	**NS**	**NS**	**6.12**	**3.99**	**4.08**	**NS**	**NS**	**NS**	**22.96**	**14.68**	**14.60**	**2.56**	**2.64**	**2.13**
Interaction (N×C)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2 : Yield attributes and yield of *rabi* forage oat as influenced by nitrogen and cutting management treatments

Treatments	Leaf : stem ratio			Green forage yield (q ha^{-1})			Dry matter yield (q ha^{-1})		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Total	1st cut	2nd cut	Total
Nitrogen levels (N)									
N_1 : 80 kg/ha	0.23	0.22	0.23	190	134	324	45	32	77
N_2 : 100 kg/ha	0.27	0.26	0.27	227	151	378	50	38	88
N_3 : 120 kg/ha	0.29	0.28	0.29	261	167	428	61	42	103
N_4 : 140 kg/ha	0.34	0.33	0.34	317	190	507	75	45	120
SEm.(±)	**0.01**	**0.01**	**0.01**	**9.1**	**3.5**	**9.2**	**2.3**	**1.4**	**2.5**
LSD(0.05)	**0.03**	**0.03**	**0.02**	**26.3**	**10.2**	**26.6**	**6.5**	**4.1**	**7.1**
Cutting management (C)									
C_1 : 45 DAS	0.27	0.26	0.27	216	144	360	50	35	85
C_2 : 55 DAS	0.29	0.28	0.28	253	171	424	58	42	100
C_3 : 65 DAS	0.30	0.27	0.29	277	167	444	65	40	105
SEm(±)	**0.01**	**0.01**	**0.01**	**7.9**	**3.1**	**8.0**	**1.9**	**1.3**	**2.1**
LSD(0.05)	**NS**	**NS**	**NS**	**22.7**	**8.8**	**23.0**	**5.6**	**3.6**	**6.1**
Interaction (N×C)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Interaction effect of nitrogen levels and cutting management on green forage yield of *rabi* forage oat

Nitrogen levels (N)	Green forage yield cutting management (q ha^{-1})			Dry matter yield cutting management(q ha^{-1})		
	C_1 : 45 DAS	C_2 : 55 DAS	C_3 : 65 DAS	C_1 : 45 DAS	C_2 : 55 DAS	C_3 : 65 DAS
N_1 : 80 kg ha^{-1}	305	333	334	72	80	81
N_2 : 100 kg ha^{-1}	337	385	412	79	88	97
N_3 : 120 kg ha^{-1}	359	451	475	83	109	116
N_4 : 140 kg ha^{-1}	442	526	553	106	125	127
SEm(±)		**16.0**			**4.3**	
LSD(0.05)		**NS**			**NS**	

to Bhilare and Joshi (2008), the dry matter production of forge oat was substantially higher when fertilized with 120 kg N ha^{-1}.

At mean levels of both cuttings, by N_4 led in the greatest crude protein content (3.20%). At mean values of both cuts, the percentage increase in crude protein content was 27.0 per cent higher with N_4 than with N_1. Singh *et al.* (2012), Joshi *et al.* (2015), Singh *et al.* (1993), Devi and Padmaja (2007), Midha *et al.* (2015), Dubey *et al*. (2013), Luikham *et al*. (2012), Bhoya *et al.* (2013) and Patel *et al.* (2010) found that as the nitrogen concentration of forage oat increases, the crude protein content increases as well.

The treatment of N_4 resulted in the greater crude fibre content (30.37%) and the minimum crude fibre content (N_1) at the mean of both cuttings, respectively. The increased crude fibre content could be attributable to increased fibre production by the plant tissue.The enhanced crude fibre content could be due to the plant tissue developing more fibre. This could be due to greater supply of desirable and essential nutrients in the plant root zone, as well as greater physiological and biochemical activity, which resulted in better partitioning of photosynthates to sinks and higher crude fibre content. These findings are similar to Singh *et al.* (1993), Golada *et al.* (2012), Jat *et al.* (2015) and Bhoya *et al.* (2013).

The application of N_4 showed significant improvement greater N content in both cuttings at mean values (0.49%).The nitrogen content recorded by the N_4 was 16.7 per cent higher than that reported by the N_1 at the mean value of both cuts.These assertions are similar to Devi *et al.* (2010), Sharma (2009) and Bhoya *et al.* (2013).

The application of N_4 to both cuttings observed in comparatively higher nitrogen uptake (59.2 kg ha^{-1}) and N_1 at the sum of both cuts resulted in the lowest nitrogen uptake (32.9 kg ha^{-1}).This data are compatible with what has been observed of Singh *et al.* (1993), Sharma (2009),

Table 4: Quality parameters and N content and uptake of *rabi* forage oat as influenced by nitrogen and cutting management treatments

Treatments	Crude protein content (%)			Crude fibre content (%)			Nitrogen content (%)			Nitrogen uptake (kg/ha)		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Nitrogen levels (N)												
N_1 : 80 kg/ha	2.67	2.37	2.52	27.90	25.61	26.76	0.46	0.38	0.42	20.7	12.2	32.9
N_2 : 100 kg/ha	2.99	2.70	2.84	29.67	26.73	28.20	0.47	0.43	0.45	23.7	16.4	40.1
N_3 : 120 kg/ha	3.17	2.86	3.01	29.90	27.20	28.55	0.48	0.46	0.47	29.2	19.2	48.4
N_4 : 140 kg/ha	3.34	3.06	3.20	31.12	29.63	30.37	0.50	0.49	0.49	37.3	21.9	59.2
SEm(±)	**0.04**	**0.04**	**0.04**	**0.36**	**0.42**	**0.30**	**0.01**	**0.01**	**0.01**	**1.13**	**0.71**	**1.21**
LSD(0.05)	**0.13**	**0.11**	**0.12**	**1.05**	**1.21**	**0.86**	**0.02**	**0.02**	**0.02**	**3.24**	**2.03**	**3.47**
Cutting management (C)												
C_1 : 45 DAS	2.98	2.68	2.83	28.51	26.58	27.55	0.47	0.43	0.45	23.4	15.2	38.6
C_2 : 55 DAS	3.04	2.79	2.92	29.69	27.40	28.55	0.48	0.45	0.46	27.8	19.2	47.0
C_3 : 65 DAS	3.10	2.77	2.94	30.74	27.90	29.32	0.49	0.44	0.46	32.0	17.9	49.9
SEm(±)	**0.04**	**0.03**	**0.04**	**0.32**	**0.37**	**0.26**	**0.01**	**0.01**	**0.01**	**0.98**	**0.61**	**1.05**
LSD(0.05)	**NS**	**NS**	**NS**	**0.91**	**1.05**	**0.74**	**NS**	**NS**	**NS**	**2.81**	**1.76**	**3.01**
Interaction (N×C)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5: Available N, P_2O_5 and K_2O in soil after harvesting and economics of *rabi* forage oat

Treatments	Available N, P_2O_5 and K_2O in soil after harvest (kg ha^{-1})			Gross monetization (Rs. ha^{-1})	Cost of production (Rs. ha^{-1})	Net monetization (Rs. ha^{-1})	BCR
	N	P_2O_5	K_2O				
Nitrogen levels (N)							
N_1 : 80 kg ha^{-1}	157.8	42.4	268.3	48600	38531	10069	1.26
N_2 : 100 kg ha^{-1}	161.3	43.6	269.2	56700	38826	17874	1.46
N_3 : 120 kg ha^{-1}	163.7	44.6	271.9	64200	39117	25083	1.64
N_4 : 140 kg ha^{-1}	168.3	44.7	274.0	76050	39407	36643	1.93
SEm(±)	**1.81**	**0.65**	**2.38**	-	-	-	-
LSD(0.05)	**5.20**	**NS**	**NS**	-	-	-	-
Cutting management (C):							
C_1 : 45 DAS	160.3	43.1	269.9	54150	38970	15180	1.39
C_2 : 55 DAS	163.6	44.1	271.1	63600	38970	24630	1.63
C_3 : 65 DAS	164.5	44.3	271.6	66600	38970	27630	1.71
SEm(±)	**1.57**	**0.57**	**2.06**	-	-	-	-
LSD(0.05)	**NS**	**NS**	**NS**	-	-	-	-

Table 6: Economics of *rabi* forage oat as influenced by nitrogen and cutting management treatments

Treatment combinations	Yield (q ha^{-1})	Cost of urea (Rs. ha^{-1})	Total cost of cultivation (Common operational cost + treatment cost) (Rs. ha^{-1})	Gross monetization (Rs. ha^{-1})	Net monetization (Rs. ha^{-1})	BCR
T_1 : N1C_1	305	821	38531	45750	7219	1.19
T_2 : N1C_2	333	821	38531	49950	11419	1.30
T_3 : N1C_3	334	821	38531	50100	11569	1.30
T_4 : N_2C_1	337	1116	38826	50550	11724	1.30
T_5 : N_2C_2	385	1116	38826	57750	18924	1.49
T_6 : N_2C_3	412	1116	38826	61800	22974	1.59
T_7 : N_3C_1	359	1407	39117	53850	14733	1.38
T_8 : N_3C_2	451	1407	39117	67650	28533	1.73
T_9 : N_3C_3	475	1407	39117	71250	32133	1.82
T_{10} : N_4C_1	442	1697	39407	66300	26893	1.68
T_{11} : N_4C_2	526	1697	39407	78900	39493	2.00
T_{12} : N_4C_3	553	1697	39407	82950	43543	2.11

Bhoya *et al.* (2013), Joshi *et al.* (2015) and Patel *et al.* (2010).

The use of 140 kg N ha^{-1} (N_4) resulted in a considerable increase in soil accessible nitrogen (168.3 kg ha^{-1}), which was 6.7 per cent greater than the use of 80 kg N ha^{-1}(N_1).This could be because greater nitrogen levels aided root multiplication and resulted in the accumulation of more accessible nitrogen in the soil as a result of root degradation. These findings are consistent with those of Singh *et al.* (2014).

Higher gross monetization (76050 Rs. ha^{-1}), net monetization (36643 Rs. ha^{-1}), and benefit cost ratio were obtained when N_4 was applied to *rabi* forage oat (1.93). Whereas, the lower gross monetization (48600 Rs. ha^{-1}), net monetization (10069 Rs. ha^{-1}) and benefit cost ratio (1.26) was observed in N_1. According to Sharma and Bhunia (2001), using 80 kg N ha^{-1}produced a higher gross return, net return, and benefit cost ratio than using 40 or 60 kg N ha^{-1}.

Effect cutting management

The effect of cutting management on plant height of rabi forage oat was significant at the first, second, and mean height of both cuts, according to data in Table 1. In mean data, cutting the crop at 65 and 45 DAS cutting (C_3) gave the highest and lowest (84.5 and 74.3 cm, respectively) plant height, but it stood at par with cutting at 55 DAS cutting (C_2). In the mean of both cuts, the tallest plants were found at 65 DAS cutting (C_3) which was 13.7 per cent higher over45 DAS cutting (C_1), respectively. Physiological processes slowed, whereas treatment C_3 resulted in continuing crop development with no disruption to the plant physiological processes led to plant height lower in the C_1 and C_2. The results are in line with those reported by Ayub *et al.* (2009), Singh *et al*. (2005) and Malik *et al.* (2015). The result of Sharma and Bhunia (2001) showed that the cutting of oat crop at 85 DAS gave highest plant height than cutting at 65 DAS.

In mean values of both cuts, cutting at 65 and 45 DAS (C_3) gave higher and lower leaf area plant^{-1} (382.1 and 344 cm^2, respectively)at mean values of both cuts, respectively (Table 1).The magnitude of increase in leaf area plant^{-1} under C_3 was to the tune of 11.1 per cent, at mean of both cuts, respectively overtreatment C_1. This could be attributed to the longer cutting interval, which provided the oat plant more time to grow, resulting in a greater plant growth attributes.These findings were very similar to those of Amit and Patel (2013).According to Malik *et al.* (2015), cutting at 70 DAS resulted in considerably more leaf area plant^{-1} of oat.

Cutting the forage oat at 65 and 45 DAS (C_3) resulted in significantly greater and lower leaf plant^{-1} numbers (37.6 and 32.0, respectively) at the mean value of both cuts (Table 1). At mean of both cut, per cent rise in number of leaves plant^{-1} was 17.5 with 65 DAS cutting (C_3) than 45 DAS cutting (C_1). The increased number of leaves plant^{-1}with respect to the plant increased height as a result of the late cutting.These results are consistent with previous research of Ayub *et al.* (2009), Bhilare and Joshi (2008), Amit and Patel (2013) and Wangchuk *et al*. (2015).

In Table 2 total values of both the cut, the higher and lower green forage yield (444 and 360 q ha^{-1}) was observed by cutting of forage oat at 65 DAS (C_3) and 45 DAS (C_1), respectively. At the sum of both cuts, the percentage increase in green forage yield by cutting at 65 DAS (C_3) was 23.0 per cent higher than the percentage increase in green forage yield by cutting at 45 DAS (C_1). It's possible that the significant rise in yields with late cutting is due to a favourable effect on yield characteristics.This could have resulted in increased photosynthetic activity as well as the creation of more photosynthates.There was also an increase in green forage output by Singh *et al*. (1997), Patel *et al.* (2003), Singh *et al*. (2005), Ayub *et al.* (2009). Patel and Alagundagi (2013) showed that the green forage yield was significantly affected by cutting the oat crop at 65 DAS as compared to 55 DAS.

In case of total values of both cuts, dry matter yield was recorded highest and (105 and 85 q ha^{-1}) by cutting of forage oat crop at 65 DAS (C_3) and 45 DAS cutting (C_1), respectively was at par with cutting at 55 DAS (C_2). At the sum of both cuts, the percentage increment in dry matter yield by cutting at 65 DAS (C_3) was 23.5 per cent higher than the percentage increase in dry matter yield by cutting at 45 DAS (C_1). According to the data, cutting at 65 DAS (C_3) yielded more dry matter than the rest of the cutting. This could be because the treatment C_3 yielded more green forage, resulting in a higher dry matter yield in the 65 DAS cutting (C_3) as compared to the 45 DAS cutting (C_1).There was also an increase in dry matter yield by Singh *et al.* (1997), Patel *et al.* (2003), Ayub *et al.* (2009) and Patel and Alagundagi (2013). Singh *et al.* (2005) found that cutting the oat at 55 DAS yielded considerably more dry matter than cutting it at 45 DAS.

The highest crude fibre content (29.32%) was recorded significantly by cutting at 65 DAS (C_3) and at 45 DAS, the lowest cutting was at the mean of both cuts, and the mean values of both cuts were 6.4 per cent greater than 45 DAS cutting (C_1), respectively (Table 4). It could be due to the stem becoming much more fibrous as the age of the oat crop advances.The outcomes are consistent with Ayub *et al.* (2009) and Alipatra *et al*. (2012) findings.

At the mean value of both cuts, the nitrogen content reported by cutting at 65 DAS (C_3) was 29.3 per cent higher than that obtained by cutting at 45 DAS (C_1) (Table 4).This data are similar to the findings of Hirpara *et al.* (2011). In terms of total nitrogen uptake (49.9 kg ha^{-1}), cutting at 65 DAS (C_3) had the highest value (49.9 kg ha^{-1}), while cutting at 55 DAS had the same value (55.9 kg ha^{-1}) (C_2).Cutting at 45 DAS (C_1) resulted in the lowest nitrogen uptake (38.6 kg ha^{-1}) at total values of both cuttings.

Cutting at 65 DAS (C_3) yielded the highest gross monetization (66600 Rs. ha^{-1}), net monetization (27630 Rs. ha^{-1}), and benefit cost ratio(1.71) when compared to other cutting methods (Table 5). Whereas, gross monetization (54150 Rs. ha^{-1}), net monetization (15180 Rs. ha^{-1}), and benefit cost ratio were the lowest (1.39) recorded under cutting at 45 DAS (C_1). This data are compatible with Sharma *et al.* (2001) and Jehangir *et al.* (2013) findings.

Interaction effect

Effect of different treatment combination

The economics of various treatment combinations have been calculated and are shown in Table 6with N_4C_3, the higher gross monetization (82950 Rs. ha^{-1}), net monetization (43543 Rs. ha^{-1}), and benefit cost ratio (2.11) were reported, followed by the treatment combinations of N_4C_2. Whereas, by sowing the *rabi* forage oat with N_1C_1, the lower gross monetization (45750 Rs. ha^{-1}), net monetization (7219 Rs. ha^{-1}), and benefit cost ratio (1.19) were showed. These assumptions are in line with the findings of Sharma *et al.* (2001).

CONCLUSION

Under north Gujarat conditions, the Kent variety of forage oat provides a maximum green forage yield andprofits to farmers when fertilized with 140 kg N ha^{-1} in the *rabi* season by cutting at 65 DAS.

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