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Impact of fodder cutting management and splitting of nitrogen doses on growth and yield of fodder Oat (*Avena sativa* L.)

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ABSTRACT

A field experiment was conducted to study the effect of fodder cutting and splitting of nitrogen management on growth and yield of various varieties of fodder oat during *Rabi* 2019-2020. The experiment was carried out with three treatments consisting of (Main plot) three varieties (RO-19, JHO-851, UPO-212) and (Sub plot) four fodder cutting and splitting of nitrogen *viz.* (T_1) two cuttings (55 DAS & 50% flowering) with 60% N as basal + 40% N at Ist cut, (T_2) Two cuttings (55 DAS & 50% flowering) with 50% N as basal + 50% N at Ist cut, (T_3) Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) with 50% N as basal+ 25% N at Ist cut + 25% N at IInd cut and (T_4) Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) with 40% N as basal + 30% N at Ist cut + 30% N at IInd cut were laid out in split plot design with three replications. As per the results the values of RO-19 obtained the highest Initial plant population and Plant height (cm) as compared to JHO-851 and UPO-212, while JHO-851, Number shoots (m^{-1}), Number leaves (m^{-1}), Leaves : Stem ratio (Plant^{-1}) and Green fodder yield (q ha^{-1}) as compared to RO-19 and UPO-212. As regarded to cutting and splitting of nitrogen management on Initial plant population, Plant height (cm), Number leaves (m^{-1}), Leaves : Stem ratio (Plant^{-1}), Green fodder yield (q ha^{-1}) and Total green fodder yield (q ha^{-1}) were found maximum under Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at Ist cut, while Number shoots (m^{-1}) were found maximum under Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at Ist cut respectively.

Key words : *Fodder cutting, Initial plant population, Leaves: Stem ratio, Plant height, Number leaves, Leaves : Stem ratio and Green fodder yield, Total green fodder yield.*

Introduction

The oat (*Avena sativa* L.) is a member of the Poaceae family. The genus *Avena* has diploid, tetraploid, and hexaploid species, all of which have an x=7 chromosomal number. Jai is the common name for oat. It is

a major cereal fodder crop that originated in the Western Mediterranean region and is typically produced during the *Rabi* season. It is used as green fodder and grain for animal nutrition. In many regions of the world, it is a major winter is a multifunctional crop that can be used for grain, grazing, fodder, or as a rotational crop. The oat plant has a great growth habit, recovers quickly after harvesting, and produces high-quality herbage (Alipatra *et al.*, 2011). The growth and yield of fodder oat are affected by a number of factors, including nitrogen fertilizer application, cutting management, and variety. Nitrogen is an essential nutrient for plant growth, and it is particularly important for the production of forage crops (Choudhary and Prabhu, 2016). Nitrogen fertilizer can be applied in a single application or in two or more splits. Splitting the nitrogen application can help to improve nutrient efficiency and reduce nutrient losses (Singh *et al.*, 2020).

Cutting management is another important factor that affects the growth and yield of fodder oat. The number of cuttings and the timing of the cuttings can have a significant impact on yield. In general, more cuttings will result in higher yields, but the timing of the cuttings is also important. Cutting too early can reduce yield, while cutting too late can reduce the quality of the forage (Pravalika, and Gaikwad 2021). The variety of fodder oat also affects the growth and yield of the crop. Some varieties are more productive than others, and some are better suited for certain growing conditions. (Sharma *et al.*, 2001) Cutting management may be used in fodder crops in general to increase yields.

Materials and Methods

The experiment was carried out during *Rabi* season 2019-20 at Genetics and Plant Breeding farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The field was well leveled having good soil condition. Geographically, Ayodhya (Kumarganj) falls in subtropical climate and is situated at 26^0 47 North latitude, 82^0 12 East longitudes with an altitude of 113 meters above mean sea level. Soil of the experiment field was classified as silt loam in texture with alkaline reaction (pH 8.8) Low in organic carbon (0.25%) and available nitrogen (190 kg ha^{-1}), medium in phosphorus (16.5 kg ha^{-1}) and potash (238.1 kg ha^{-1}). The experiment was laid out in split plot design with three replications. The main plot consisted of three oat varieties (RO-19, JHO-19 and UPO-212), whereas sub-plot had three nitrogen levels (Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at I^{st} cut, Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at I^{st} cut, Three cuttings (55 DAS, 35 days after 1^{st} cut & 50% flowering) + 50% N as basal + 25% N at I^{st} cut + 25% N at II^{nd} cut and Three cuttings (55 DAS, 35 days after 1^{st} cut & 50% flowering) + 40% N as basal + 30% N at I^{st} cut + 30% N at II^{nd} cut). The sowing was done on 18 November 2019 in opened furrows at 25 cm apart using the seed rate of 100 kg ha^{-1}.

Growth and yield observations

Initial Plant Population (m^{-1})

The initial plant population was recorded at 15 days after sowing. It was recorded by counting the plant of one meter row length from randomly selected three place in each net plot with the help of scale and then averaged in (m^{-1}) row length

Plant height (cm)

The height of five randomly selected plants was measured in centimeters from ground level up to tip of the plant with the help of a meter scale. Plant height was measured at 55 DAS (first cut) and at each cut of crop and the mean plant height was calculated.

Number of shoots (m^{-1})

The total number of tillers per meter row length was recorded from the randomly selected rows in each plot and their mean was determined. It was taken at 55 days after sowing.

Number of leaves (m^{-1})

The number of leaves per meter row was recorded from the randomly selected rows in each plot and their mean determined. It was taken at 55 day after sowing.

Leaf: Stem ratio

Five plants were selected randomly in each plot for Leaf : Stem ratio. per plant of the oat crop is taken at each cut. The representative sample leaf and stem was separated and the weight recorded. For obtaining leaf : stem ratio, leaf weight was divided by stem weight.

Leaf area index (LAI)

The leaf area was measured at 55 DAS and at each cut. It could not be recorded at harvest because of complete drying of leaves. The plants of 25 cm row length were taken and green leaves were separated to record their surface area by automatic leaf area meter. All the leaves were grouped into three *viz.,* small, medium and large. Five leaves were taken from each group and their surface area measured. Area of five leaves was multiplied with respective leaf numbers of a group and sum of all three gave the total leaf area. For obtaining index, leaf area divided by ground area.

Green fodder yield

The cutting of green fodder of each net plot was done as per the treatments and then weighted accurately in fraction of kg per plot at convert in q ha^{-1}.

Total green fodder yield (q ha^{-1})

The total green fodder yield produced from each net plot was harvested, weighed and then converted into q ha^{-1}.

Results and Discussion

Initial Plant Population (m^{-1})

The data observed was on initial plant population as significantly not affected by varieties and cutting and splitting of nitrogen levels of oat at 15 DAS are presented in Table 1.

The maximum plant population (30.5) was observed with the variety of RO 19 and minimum plant population counted with the variety of UPO-212, and cutting and splitting of nitrogen by the maximum initial plant population (29.87) was recorded at two cutting (55 DAS and 50 % flowering) + 50 % nitrogen as basal + 50 % nitrogen at I^{st} cut , where as minimum (29.47) was recorded at three cut (55DAS, 35 days after first cut and 50 % flowering) +40 % nitrogen as basal + 30 % nitrogen at first cut + 30 % nitrogen at II^{nd} cut. The plant population lowest might due to most of the seed at time of sowing remain unmixed/lying on upper surface of the soil which cause it not get the favorable climate by long time results it dried or eaten by birds due to which reduced the plant population of any particular treatment. The similar result of initial plant population reported by Kaur and Goyal, (2017).

Plant height (cm)

The data pertaining to plant height was recorded at various cut as per treatments that influenced significantly by varieties and cutting & splitting of nitrogen of oat have been summarized in Table 1.

The maximum plant heights (58.13, 85.45 and 36.88 cm. respectively) were recorded with the variety of RO-19, which was at par with variety of UPO-212 (55.93, 83.44 and 35.73 cm) at various cutting stages. Plant height increases with various variety genetically variability. The observation of data indicate that the cutting and splitting of nitrogen, two cutting + 60 % nitrogen basal + 40 % nitrogen at I^{st} cut obtained maximum plant height (56.47cm) at first cut at par with plant height (55.80 and 55.60cm) at two cutting+50 % nitrogen as basal+50 % nitrogen at I^{st} cut and three cut+ 50 % nitrogen as basal + 25 % nitrogen at I^{st} cut + 25 % nitrogen at II^{nd} cut. Plant height at second cut affected significantly by two cutting + 60 % nitrogen as basal + 40 % nitrogen at I^{st} cut at par with two cuttings + 50 % nitrogen as basal + 50 % nitrogen at I^{st} cut. Third cut was recorded maximum plant height (42.67cm) at three cuttings + 40 % nitrogen as basal + 30 % nitrogen at I^{st} cut + 30 % nitrogen at II^{nd} cut at par with three cuttings + 50 % nitrogen as basal + 25 % nitrogen at I^{st} cut + 25 % nitrogen at II^{nd} cut. The increase in plant height was due to less competition of plant with weeds for space, nutrients and other things. Similar results have also been reported by Singh *et al*. (2001)

Number of shoots (m^{-1})

The observations data number of shoots (m^{-1}) were recorded by varieties and cutting and splitting of crop and presented in Table 1. An examination of data found that number of shoots was influenced significantly due to by varieties and cutting & splitting of nitrogen.

It is distinctly evident that the number of shoots (m^{-1}) was affected significantly by cutting and splitting of nitrogen and various varieties of oat at all cut stages of crop. Number of shoots (100.38, 134.85 and 75.62 m^{-1}) was recorded by variety JHO-851at par with shoots of variety RO-19 (97.51, 131.58 and 74.29 m^{-1}) and lowest number of shoots variety UPO-212. (88.91, 127.87 and 69.62 m^{-1}). Cutting and splitting of nitrogen difference in relation to number of shoots (m^{-1}) was found significant at 55 DAS, 35days after first cut and 50 % flowering stage. Further scanning

Table 1. Initial plant population (m^{-1}), Plant height (cm), Number shoots (m^{-1}) and Number leaves (m^{-1}) at subsequent cutting as influenced by splitting of nitrogen on different varieties of oat. (*Avena sativa* L.)

Treatments	Initial plant population (m^{-1})	Plant height (cm)			Number shoots (m^{-1})			Number leaves (m^{-1})		
		(Ist cut)	(IInd cut)	(IIIrd cut)	(Ist cut)	(IInd cut)	(IIIrd cut)	(Ist cut)	(IInd cut)	(IIIrd cut)
Varieties										
RO - 19	30.50	58.13	85.45	36.88	97.51	131.58	74.29	745.21	775.20	351.90
JHO – 851	29.60	53.45	79.34	34.83	100.38	134.85	75.62	767.13	798.00	355.35
UPO - 212	29.45	55.93	83.44	35.73	88.91	127.87	69.62	679.46	706.80	327.75
SEm±	0.66	1.16	1.52	0.67	1.97	2.31	1.16	14.88	9.49	6.37
CD at 5%	NS	3.42	4.47	2.01	5.78	6.93	3.40	43.64	27.83	18.68
Cutting and splitting of nitrogen management										
Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at Ist cut	29.67	56.47	99.28	0.00	98.47	132.48	0.00	759.82	802.35	0.00
Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at Ist cut	29.87	55.80	99.50	0.00	95.51	133.43	0.00	745.21	818.08	0.00
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 50% N as basal + 25% N at Ist cut + 25% N at IInd cut	29.80	55.60	64.99	41.68	93.69	124.86	71.30	739.38	651.65	360.21
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 40% N as basal + 30% N at Ist cut + 30% N at IInd cut	29.47	51.73	67.19	42.67	91.32	130.64	74.05	701.24	667.38	424.79
SEm±	0.76	1.34	1.76	0.62	2.27	2.67	0.76	17.18	20.10	4.20
CD at 5%	NS	4.02	5.16	1.84	6.81	8.01	2.25	51.54	58.96	12.34

of the Table reveals that at first cut maximum number of shoots (98.47 m^{-1}) was noticed under two cuttings + % as basal + 40 % nitrogen at Ist cut which was affected significantly at par with number shoots (95.51 m^{-1}) two cuttings + 50 % nitrogen as basal + 50 % nitrogen at 1st cut and three cuttings + 50 % nitrogen as basal + 25 % nitrogen at Ist cut + 25 % nitrogen at IInd cut. At second cut the maximum numbers of shoot (133.43 $plant^{-1}$) was found two cuttings + 50 % nitrogen as basal + 50 % nitrogen at Ist cut at par with two cuttings + 50 % nitrogen as basal + 50 % nitrogen at Ist cut and three cuttings + 40% nitrogen as basal + 30% nitrogen at Ist cut + 30 % nitrogen at IInd cut, and at thirds cut maximum number shoot (74.05) was recorded at par with three cuttings + 50% nitrogen as basal + 25% nitrogen at Ist cut + 25% nitrogen at IInd cut. Higher number of tillers resulted in increased the absorption of nitrogen subsequently increased the green fodder yield.

Number leaves (m^{-1})

The observations on number of leaves (m^{-1}) were recorded at different cutting stages of crop in Table 1, an examination of data manifests that number of leaves was significantly influenced by cutting and splitting of nitrogen and varieties.

The varietal difference that number of leaves (m^{-1}) was affected significantly by all the treatments of crop growth. Number of leaf (767.13, 798.00 and 355.35 m^{-1}) variety JHO- 851 was found superior significantly at par with number of leaves (745.21, 775.20 and 351.90 m^{-1}). Variety RO-19 over rest of the variety UPO-212. The data observed of Cutting and splitting of nitrogen on number of leaves (m^{-1}) was found significantly at all cut stages of crop. In first recorded maximum number of leaves (759.82m^{-1}) affected significantly at par with number of leaves (745.21 and 739.38 m^{-1}) two cuttings + 50 % nitrogen as basal + 50 % nitrogen at 1st cut and Three cuttings (55 DAS, 35 days after 1st cut & 50 % flowering) + 50 % nitrogen as basal + 25 % nitrogen at 1st and second cut

observed number leaves (818.08 m^{-1}) at two cuttings + 50 % nitrogen as basal + 50 % nitrogen at 1st cut significantly maximum at par with leaves (802.35 m^{-1}) two cuttings + 60 % nitrogen as basal + 40 % nitrogen at 1st cut and three cut of crop was found number of leaves (424.79 m^{-1}) at Three cuttings + 40 % nitrogen as basal + 30 % nitrogen at 1st cut + 30% nitrogen at 2nd cut highest significantly over rest of the Three cuttings + 50 % nitrogen as basal + 25 % nitrogen at 1st cut + 25 % nitrogen at 2nd cut. Higher number of leaves resulted in increased the absorption of nitrogen subsequently increased the green fodder yield.

Leaves: stem ratio (Plant^{-1})

Perusal of data presented in Table 2 clearly reveals that the various varieties by significantly affected leaves : stem ratio. The maximum leaves: stem ratio of variety JHO – 851 (0.73) at 55DAS (Ist cut), (1.02) 35 Days after first cut (IInd cut) and (0.30) 50%flowering (IIIrd cut) significantly at par with leaves : stem ratio (0.71, 1.00 and 0.58 Plant^{-1}) at variety RO – 19 over rest of the UPO – 212 all cut stage respectively. The data recorded Leaves: stem ratio (Plant^{-1}) was found significantly affected by cutting and splitting of nitrogen at all cutting stages except of the 55 DAS. The maximum leaves: stem ratio (1.01 Plant^{-1}) at two cuttings + 50 % nitrogen as basal + 50 % nitrogen at Ist cut significantly higher at with leaves: stem ratio (1.00 Plant^{-1}) at two cuttings + 60 % nitrogen as basal + 40 % nitrogen at Ist cut. while the leaves : stem ratio (0.59 Plant^{-1}) at three cuttings (55 DAS, 35 days after 1st cut & 50 % flowering) + 40 % nitrogen as basal + 30 % nitrogen at Ist cut + 30 % nitrogen at IInd cut was recorded maximum at third cut and over rest of the other treatments. The result similar might be due finding by kumari *et al.*, (2014).

Green fodder yield (q ha^{-1})

The green fodder yield of oat as influenced by cutting and splitting of nitrogen levels and various varieties are presented in Table 2.

The data recorded were various varieties on green fodder yield (q ha^{-1}) affected all growth stages. The variety JHO-851on green fodder yield (227.25 362.25 and 152.77 q ha^{-1}) significantly maximum then at par with green fodder yield (225.25, 342.75 and 148.01 q ha^{-1}) variety RO – 19 at 55 DAS (Ist cut), 35 Days after first cut (IInd cut) and 50 % flowering stage over rest of the green fodder yield (177.25, 333.25 and 145.73 q ha^{-1}) variety UPO-212. The data pertaining to the green fodder yield was signifi-

Table 2. Leaves : Stem ratio (Plant^{-1}), Green fodder yield (q ha^{-1}) and Total green fodder yield (q ha^{-1}) at subsequent cutting as influenced by splitting of nitrogen on different varieties of oat. (*Avena sativa* L.)

Treatments	Leaves : Stem ratio (Plant^{-1})			Green fodder yield (q ha^{-1})			Total green fodder yield (q ha^{-1})
	(Istcut)	(IInd cut)	(IIIrd cut)	(Istcut)	(IInd cut)	(IIIrd cut)	
Varieties							
RO-19	0.71	1.00	0.58	225.25	342.75	148.01	714.01
JHO–851	0.73	1.02	0.60	227.25	362.25	152.77	737.27
UPO-212	0.66	0.92	0.57	177.25	333.25	145.73	656.23
SEm±	0.013	0.022	0.005	4.07	7.72	1.39	11.83
CD at 5%	0.037	0.066	0.016	11.94	22.64	4.17	34.70
Cutting and splitting of nitrogen management							
Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at Ist cut	0.72	1.00	0.00	224.33	419.33	0.00	643.66
Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at Ist cut	0.70	1.01	0.00	216.67	434.00	0.00	650.67
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 50% N as basal + 25% N at Ist cut + 25% N at IInd cut	0.69	0.92	0.57	215.62	259.67	147.98	623.27
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 40% N as basal + 30% N at Ist cut + 30% N at IInd cut	0.68	0.95	0.59	209.00	271.33	154.02	634.35
SEm±	0.014	0.026	0.006	4.70	8.91	1.61	15.22
CD at 5%	NS	0.078	0.018	14.10	26.15	4.72	NS

cantly influenced by different cutting and splitting of nitrogen at all cutting stages of crop. The green fodder yield (224.33 q ha-) was recorded maximum with treatment two cuttings (55 DAS and 50% flowering) + 60 % nitrogen as basal + 40 % nitrogen at Ist cut at par with green fodder yield (216.67 and 215.62 q ha^{-1}) at Two cuttings (55 DAS & 50 % flowering) + 50 % nitrogen as basal + 50 % nitrogen at Ist cut and Three cuttings (55 DAS, 35 days after 1st cut and 50 % flowering) + 50 % nitrogen as basal + 25 % nitrogen at Ist cut + 25 % nitrogen at IInd cut. The green fodder yield (434.00 q ha^{-1}) was found significantly maximum at second cut at two cuttings (55 DAS and 50 % flowering) + 50 % nitrogen as basal + 50 % nitrogen at 50 % flowering at par with green fodder yield (419.33q ha^{-1}) at two cuttings (55 DAS and 50 % flowering) + 60 % nitrogen as basal + 40 % nitrogen at 50 % flowering. Third cut at green fodder yield (154.02 q ha^{-1}) significantly higher at three cuttings (55 DAS, 35 days after 1st cut and 50 % flowering) + 40 % nitrogen as basal + 30 % nitrogen at Ist cut + 30 % nitrogen at IInd cut over rest of the three cuttings (55 DAS, 35 days after 1st cut and 50 % flowering) + 50 % nitrogen as basal + 25 % nitrogen at Ist cut + 25 % nitrogen at IInd cut result might be due to more regeneration capacity of oat after each cutting may be the reason for higher green fodder yield. Similar results have also been reported by Bollaveni *et al*. 2015.

Total green fodder yield (q ha^{-1})

The data with respect to total green fodder yield of oat at harvest of the crop as influenced significantly by cutting and splitting of nitrogen and various varieties of oat are present in Table 2.

The total green fodder yield differs due to various varieties. The total green fodder yield (737.27q ha^{-1}) was observed by variety JHO-851 maximum at par with total green fodder yield (714.01 q ha^{-1}) variety RO-19 and found significantly superior over rest of the varieties. While the lowest total green fodder yields (656.23q ha^{-1}) was recorded variety UPO-19. The data observed total green fodder yield on cutting and splitting of nitrogen not affected significantly. The total green fodder (643.66 q ha^{-1}) was found maximum at two cuttings (55 DAS & 50 % flowering) + 60 % nitrogen as basal + 40 % nitrogen at 1st cut where as minimum total green fodder yield (623.27 q ha^{-1}) at three cuttings (55 DAS, 35 days after 1st cut & 50 % flowering) + 50 % nitrogen as basal + 25 % nitrogen at 1st cut + 25 % nitrogen at 2nd cut. The findings are closely related with the findings of Sharma *et al.*, (2001), Sharma and Verma (2005).

Conclusion

Conclusively as per the results the values of RO-19 obtained the highest Initial plant population and Plant height (cm) while JHO-851, Number shoots (m^{-1}), Number leaves (m^{-1}), Leaves : Stem ratio (Plant^{-1}) and Green fodder yield (q ha^{-1}) and Total green fodder yield (q ha^{-1}) significantly. cutting and splitting of nitrogen management, on Initial plant population, Plant height (cm), Number leaves (m^{-1}), Leaves : Stem ratio (Plant^{-1}), Green fodder yield (q ha^{-1}) and Total green fodder yield (q ha^{-1}) were found maximum under Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at Ist cut, while Number shoots (m^{-1}) were found maximum under Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at Ist cut respectively.

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Conflict of Interest

None

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