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INFLUENCE OF SOWING DATES AND CUTTING INTERVALS ON GROWTH AND SEED YIELD OF ALFALFA (*MEDICAGO SATIVA* L.) CV. RL-88

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SUMMARY

An experiment was carried out at the department of Seed Science and Technology (E-block) College of Agriculture, UAS, GKVK, Bengaluru to find out the optimum date of sowing and cutting interval in alfalfa. The results on growth parameters indicated that significantly highest plant height, forage yield (Fresh and dry forage yield) was recorded by 1st July sowing +no cutting over the cutting intervals followed. Similarly, the less number of days taken to flower initiation and days to 50 % flowering noticed in 15th August sown crop + cut followed at 60 DAS (D_4C_1). The number of vegetative and generative branches per plant also found maximum in D_4C_1. The number of seeds per pod (6.67), seed yield (1.49 g plant^{-1}), seed yield (161.07 g plot^{-1}) and seed yield (355.00 kg ha^{-1}) recorded higher in crop sown at 15th August + cutting followed at 60 DAS were recorded over others sowing dates and cutting interval.

Key words : alfalfa, cutting intervals, vegetative and generative branches, dry matter

The prime importance of livestock to Indian Agriculture well recognized. The low productivity of livestock is a matter of concern, which is mainly due to the poor fodder and feed resources. Livestock serves energy fuel to Indian Agriculture and also the source of employment. Alfalfa (*Medicago sativa* L.) is popularly known as lucerne and rightly called as "Queen of Forage" in India. It has been under cultivation under wide range of climatic and soil conditions throughout the world since ages. In Karnataka it is popularly called as Kudre Masale/ Kudare Menthe.

Seed production in forage crops is very scanty and there is huge demand for seeds of forage crops. In order to make avail the quality seed produced in the previous year, effective seed storage techniques are at infant stage. Seed is the most critical and important input to enhance the production potential of all agricultural crops, including fodder. The efficacy of other inputs is largely dependent on availability and timely sowing of quality seeds of improved genetics. Therefore, an assured supply of fodder seeds of improved varieties or hybrids to farmers at a reasonable price is crucial for enhancing fodder production. Therefore, production of quality seeds is one of the major hinders in alfalfa due to many reasons *viz*., a) Physiological reasons: very poor seed-setting and low seed production ability of most of the varieties, many of forage species are of indeterminate growth habit, poor translocation mechanism of photosynthates from vegetative to reproductive structures, Non-synchronization of flowering, prolonged flower drop and uneven maturity, improper management of monetary and non-monetary inputs especially in forage crops, Preferential use of low capability marginal lands and rainfed conditions for raising most of the forage seed crops and low insect activity during hot summer months results in low seed productivity in entamophilous allogamous legume species. b) Others, blank seeds, seed dormancy, apomixes, seed shedding and harvesting.

Alfalfa has good production potential, but

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lack of suitable agro techniques (*i.e*. seed rate, time of sowing, cutting intervals and fertility level, different insect pollinator for tripping etc.) is responsible for reduction of quantity and quality of forage yield. In this regard a study to standardize the sowing time and cutting intervals on forage and seed yield of alfalfa were carried out. The time of first cut after sowing is important to obtain maximum number of cuts as well as green forage yield at each cut. Thus, cutting management not only provides information about the regeneration potential of the crop but also growth peak and yield too. Moreover, the cutting management may be responsible for quality & quantity for forage crops and particularly for alfalfa forage yield.

MATERIALS AND METHOD

An experiment on effect of date of sowing and cutting intervals on growth, forage and seed yield of alfalfa (*Medicago sativa* L.) cv. RL-88 under Eastern Dry Zone of Bengaluru was carried out at Seed Science and Technology, experimental E-block, GKVK, University of Agricultural Sciences, Bengaluru during *kharif* / *rabi* season of 2015. Field experiment laid out in Factorial Randomized Block Design with three replication with Gross plot size: 2.1 m x 2.0 m=4.20 m^2 spacing followed 30 x 10 cm. Treatment comprises of four different dates of sowing D_1: 1st July, D_2: 15th July, D_3: 1st August and D_4: 15th August with four cutting management *viz.*, C_0: no cut, C_1: First cut @ 60 DAS, C_2: Second cut @ 85 DAS and C_3: Third cut @ 110 DAS carried out at different stage of crop growth.

RESULTS AND DISCUSSION

Effect of dates of sowing and cutting intervals on growth parameters of alfalfa

The time of cutting intervals and cutting frequency are also a very important agronomic practice for forage crops. The time of first cut after sowing is important to obtain maximum number of cuts as well as green forage yield at each cut. Thus, cutting management not only provides information about the regeneration potential of the crop but also growth peak and yield too. Moreover, the cutting management may be responsible for quality & quantity of forage as well the seed yield.

Dates of sowing

The effect of dates of sowing shows numerically higher significant difference with respective plant growth attributes (Table. 1 and 2.). the crop sown during 1st July recorded significant higher plant height (69.46 cm), fodder fresh weight (609.43 kg ha^{-1}), fodder dry weight (128.26 kg ha^{-1}) these attributes was reduced to tune (8 %, 4.2 % and 8.6 %, respectively) in D_4: 15th August date sowing. The data clearly indicates a significant reduction in growth parameters with successive delay in sowing dates. This might be due to the sufficient time available for successful completion of vegetative phage under the conducive environmental conditions, which promoted the better root and vegetative growth and ultimately resulted in more green forage and dry matter yields of the plant. These results are in conformity with the findings of Amit Kumar and Patel, (2013) in lucerne, Sonu Ram *et al*. (2014) in lucerne and Subhan Ud Din *et al*. (2015) berseem.

The number of days taken for first flower initiation and days to 50 % flowering (95.67 and 102.75 days, respectively) were higher in D_1: 1st July sown crop (Fig. 3.3 and Fig. 3.4). Whereas, in delayed sown dates (D_4: 15th August) the flowering commenced early (76.92 and 82.17 days, respectively). The delayed flowering with early sown crop might be due to decreased temperature in delayed sowing (monsoon commencement in July month rains, much higher relative humidity) that might have prolonged vegetative phase of the crop growth. Flowering time flexibility is a commonly happening adaptive feature of fodder crops. Flowering time is primarily influenced by temperature, genotype and photoperiod. It has normally been confirmed that flowering time is a common adaptive aspect of annuals, including legumes, in arid or semiarid environments (Ehrmann and Cocks, 1996). Time from sowing to flowering decreased as sowing was late which resulted in increasingly shorter growing season. Days to 50 % flowering is significantly affected by planting dates. These results are in accordance with the findings of Prasad *et al.* (2012) in chick pea and Amit Kumar and Patel (2013) in lucerne.

Cutting intervals

The effect of different cutting intervals was found significant at 85, 100 and at harvest. The highest plant height (66.51 cm) recorded in C_3: Cut at 110 DAS, followed by C_0: no cut (66.38 cm), C_2: Cut at 85 DAS (64.04) and C_1: Cut at 60 DAS (40.46 cm). Similar trend, at 110 DAS the plant height (71.46 cm) was noticed higher in C_3: Cut at 110 DAS, followed

by C_0: no cut (69.72 cm), C_1: Cut at 60 DAS (53.54 cm) and C_2: Cut at 85 DAS (44.25 cm).

Among the treatments the C_0: no cut recorded highest plant height (82.38 cm) at harvest, over C_1: Cut at 60 DAS, C_2: Cut at 85 DAS and C_3: Cut at 110 DAS (66.42 cm, 61.83 cm and 55.79 cm, respectively). This might be due to the long spell of cutting interval providing enough time for photosynthesis leading to higher growth which ultimately resulted in higher plant height.

The green forage yield and as well as the dry forage yield was also significantly influenced by the cutting interval stage. The forage yield (green and dry) was recorded maximum (602.06 kg ha^{-1} and 127.03 kg ha^{-1}, respectively) in no cut, the percent reduction is (2.6 % and 3.00 %, respectively) noticed in cutting intervals carried out C_1: Cut at 60 DAS (586.61 kg ha^{-1} and 123.23 kg ha^{-1}, respectively). This might be due to more cutting intervals later stages of crop reduced the regeneration and developmental efficiency. The initial cutting at 60 DAS and then left for seed production recorded significantly higher straw yield over initial cut at 75 and 90 DAS. The lower straw yield from the oat initially harvested at 75 and 90 DAS may

TABLE 1
Effect of dates of sowing and cutting intervals on plant height, number of vegetative and generative braches per plant of alfalfa (Medicago sativa L.) Cv. RL-88

Treatments	Plant height (cm)				Vegetative branches/ plant	Generative branches/ plant
	60 DAS	85 DAS	110 DAS	At harvest		
Dates of Sowing (D)						
D1: 1st July	59.21	55.54	58.00	69.46	17.33	10.83
D2: 15th July	62.92	59.67	61.38	68.17	17.83	10.83
D3: 1st August	61.75	60.25	58.92	63.92	17.00	10.33
D4: 15th August	62.65	61.93	60.75	64.88	19.50	11.67
S. Em±	1.32	0.27	0.23	0.36	1.01	0.69
CD (P=0.05)	NS	0.95	0.79	1.26	NS	NS
Cutting intervals (C)						
C0: No cut	63.71	66.38	69.79	82.38	15.25	9.08
C1: First cut @ 60 DAS	60.13	40.46	53.54	66.42	21.17	13.08
C2: Second cut @ 85 DAS	61.00	64.04	44.25	61.83	18.75	11.25
C3: Third cut @ 110 DAS	61.69	66.51	71.46	55.79	16.50	10.25
S. Em±	1.89	0.31	0.41	0.04	0.27	0.35
CD (P=0.05)	NS	0.91	1.21	0.11	0.80	1.03
INTERACTON (DXC)						
D1C0	63.17	65.83	70.50	89.17	16.33	8.67
D1C1	57.00	32.67	55.33	65.33	20.33	13.33
D1C2	56.33	60.33	40.33	66.33	17.33	10.67
D1C3	60.33	63.33	65.83	57.00	15.33	10.67
D2C0	67.00	66.67	70.67	80.00	14.33	8.67
D2C1	60.50	42.00	59.83	76.00	22.33	13.33
D2C2	64.17	66.33	43.67	61.00	18.67	11.67
D2C3	60.00	63.67	71.33	55.67	16.00	9.67
D3C0	61.83	65.00	69.33	79.33	14.33	9.00
D3C1	61.33	42.83	50.33	63.67	19.00	12.33
D3C2	60.17	63.17	45.33	59.67	19.00	10.67
D3C3	63.67	70.00	70.67	53.00	15.67	9.33
D4C0	62.83	68.00	68.67	81.00	16.00	10.00
D4C1	61.67	44.33	48.67	60.67	23.00	13.33
D4C2	63.33	66.33	47.67	60.33	20.00	12.00
D4C3	62.77	69.03	78.00	57.50	19.00	11.33
S. Em±	3.78	0.62	0.83	0.52	0.55	0.71
CD (P=0.05)	NS	1.82	2.42	1.53	1.60	NS
CV	9.61	19.43	20.14	16.10	18.81	19.07

NS–Not Significant.

be due to poor regeneration resulting in lower straw production. Cutting three times (C_3) had a high significant effect on plant height at 60 days compared to other cutting management. This might be due to the fact that increasing the number of cutting permits the growth of more branches from the crown buds at the base of the stem. This result is in agreement with Granfield (1964) who reported that alfalfa generally recommended be cutting and then leaving to re-growth.

Interaction (DXC)

The combined effect of date of sowing and cutting intervals on different growth parameters *viz*., plant height at 60 DAS and generative tillers per plant was found non-significant.

Significantly the highest plant height, was observed under treatment combination D_1C_0 (89.17 cm). While the, D_1C_3 recorded the maximum forage fresh weight and dry weight (625.63 kg ha^{-1} and 131.25 kg ha^{-1}, respectively). This might be due to favorable temperature effects and longer time of cutting intervals increased the growth parameters of the alfalfa *i.e*., plant height and number of leaves per plant. These results are in agreement with the finding of Amit Kumar and Patel (2013) in alfalfa.

The significantly less number of days taken for flower initiation and 50 % flowering (73.67 and 79.33 days, respectively) recorded in D_4C_3: (15th August sown crop, cut at 110 DAS). Which is around 30 days earlier to that of the crop taken for sowing in 1st July, no cutting treatment (D_1C_0).

Effect of dates of sowing and cutting intervals on yield attributes

The seed yield of alfalfa was significantly influenced by dates of sowing (Table. 3 and 4). The highest seed yield of 322.00 kg per hectare was recorded in D_4: 15th August sown crop. The percent reduction in seed yield (30.90 %, 26.46 % and 12.86 %, respectively) in the other sowing dates *viz.*, on D_1: 1st July (222.52 kg), D_2: 2nd July (236.79 kg) and D_3: 1st August (280.59 kg). The higher seed yield obtained in D_4: 15th August is mainly due to seed yield per plant (1.35 g) and seed yield per net plot (146.13 g). This might be due to favorable temperature during crop growth period resulting in increased number of pods per plant and seeds per pod and higher growth attributes, which may be responsible for better source sink relationshipbetween environment and fertilization of lucerne. They indicated that numbers of filled pods/ plant were positively correlated with the pollen tube length. Under the delayed sowing the crop was exposed to comparatively higher temperature (36 ^{o}C to 40 ^{o}C) during flowering period as compared to earlier sowing time. This might have increased the pollen tube length and "**autotripping of flowers"** consequently led to increase in all the yield attributes. Hence, the temperature prevailing during flowering period in terms of longer day length and better sun light under the treatments of later sowing might be optimum for better fertilization and seed setting diversification of more plant energy to the development of reproductive organ. These results are conformity with those results obtained by Kabir *et al*. (2009) in chickpea and Gawariya *et al*. (2015) in forage mustard.

Cutting interval (C)

The results of this study revealed the significant and consistent effect of cutting treatments on various seed yield attributing and quality parameters studied. As number of cuttings increased from C_0 (no cut) crop to three cuts at different crop growth stages.

Initial cutting at 60 days after sowing and then left for seed production recorded significantly higher seed yield (297.51 kg ha^{-1}) followed by percentage reduction in yield over best treatment *viz.*, (22.60 %, 6.60 % and 14.08 %, respectively) C_0: no cut (230.44 kg ha^{-1}), C_2: cut taken at 85 (278.02 kg ha^{-1}) and C_3:110 DAS (255.93 kg ha^{-1}). Initial period of cutting at 60 DAS produced maximum and significantly more number of seeds per pod (5.92), seed yield per plant (1.27 g) and seed yield per net plot (136.40 g). Thus, these results revealed the adverse effect of cutting management on seed yield and fodder yield of alfalfa as the number of cuttings from no cut to three cuts @ 60, 85 and 110 DAS. It is also obvious that the increase in number of cuttings up to three cutting interval might have disturbed the normal growth of cut plants causing slower re-growth, poor production of fertile tillers, delayed inflorescence emergence and poor synchronization of productive tillers which might have ultimately resulted into poor seed setting and weight per plant as well as fodder yield per plant.

Interaction (DXC)

The experiments revealed the marked variations on seed yield attributing parameters due to interaction between sowing dates and cutting intervals (D x C) at their same and different levels.

The seed yield of alfalfa was significantly

TABLE 2
Effect of dates of sowing and cutting intervals on days taken to flower initiation, days to 50% flowering, forage dry matter content and racemes per plant of alfalfa (Medicago sativa L.) Cv. RL-88

Treatment	First flower initiation (days)	Days to 50% flowering	Forage dry matter content (kg/ha)	
			Fresh weight basis	Dry weight basis
Dates of Sowing (D)				
D1: 1st July	95.67	102.75	609.43	128.26
D2: 15th July	88.67	93.42	592.51	124.52
D3: 1st August	83.42	88.25	597.69	125.75
D4: 15th August	76.92	82.17	557.51	117.34
S. Em±	0.49	0.90	2.70	0.07
CD (P=0.05)	1.68	3.11	9.33	0.24
Cutting intervals (C)				
C0: No cut	83.42	92.25	602.06	127.02
C1: First cut @ 60 DAS	82.08	86.33	584.46	122.83
C2: Second cut @ 85 DAS	88.33	92.67	584.01	122.80
C3: Third cut @ 110 DAS	90.83	95.33	586.61	123.23
S. Em±	1.06	1.04	1.36	0.11
CD (P=0.05)	3.11	3.05	3.96	0.32
INTERACTON (DXC)				
D1C0	83.67	98.00	612.33	130.07
D1C1	87.00	91.33	613.63	128.41
D1C2	104.00	108.33	586.14	123.33
D1C3	108.00	113.33	625.63	131.25
D2C0	82.67	90.67	607.93	127.85
D2C1	82.00	86.33	586.26	123.18
D2C2	98.00	102.33	597.14	125.32
D2C3	92.00	94.33	578.73	121.72
D3C0	86.67	94.00	605.84	127.55
D3C1	80.67	84.33	590.56	124.55
D3C2	76.67	80.33	604.16	126.93
D3C3	89.67	94.33	590.21	123.98
D4C0	80.67	86.33	582.14	122.60
D4C1	78.67	83.33	547.39	115.18
D4C2	74.67	79.67	548.60	115.60
D4C3	73.67	79.33	551.89	115.97
S. Em±	2.13	2.09	2.71	0.22
CD (P=0.05)	6.22	6.10	7.91	0.64
CV	12.30	11.36	4.12	3.92

influenced by dates of sowing and cutting intervals (D x C). The highest seed yield of 355.00 kg per hectare was recorded in D_4C_1: 15th August sown crop with cutting interval imposed at 60 DAS. The percent reduction in seed yield (7.38 %, 8.05 %, 14.10 %, and 52.10 %, respectively) recorded in the other sowing dates *viz.,* on D_3C_1: 1st August sown crop with cutting interval imposed at 60 DAS (328.81 kg ha^{-1}), D_4C_2: 15th August sown crop with cutting interval imposed at 85 DAS (326.43 kg ha^{-1}), D_4C_0: 15th August sown crop with no cut (305.00 kg ha^{-1}) and D_1C_0: 1st July sown crop with no cut (170.08 kg ha^{-1}) as control.

The seed per pod (6.67), seed yield per plant (1.49 g) and seed yield per net plot (161.07 g) and harvest index (0.7076) were recorded in D_4C_1(15th August sowing, second cut at 60 DAS). The consistent increase in seed yield components seen in D_4C_1 interaction may be attributed due to the synergetic effect of early sowing in June month and early crop growth cutting help in robust crown development and production of maximum number of seed yield attributing parameters in nut shell. These results are in conformity with the findings of Sunitha Devi and Satyanarayana Rao (2007) in forage cow peaand

TABLE 3
Effect of dates of sowing and cutting intervals on pods per raceme, filled pods per raceme, total number of pods per plant and number of filled pods per plant of alfalfa (Medicago sativa L.) cv. RL-88

Treatments	No. of plds/ raceme	Filled pods raceme	Total number of plds/plant	No. of filled pods/ plant
Dates of Sowing (D)				
D1: 1st July	11.08	4.50	146.58	76.27
D2: 15th July	12.92	5.08	186.25	84.99
D3: 1st August	12.83	5.08	155.67	90.05
D4: 15th August	13.83	5.75	215.42	108.24
S. Em±	0.35	0.17	1.08	0.43
CD (P=0.05)	1.20	0.60	3.73	1.49
Cutting intervals (C)				
C0: No cut	12.17	4.50	144.92	75.36
C1: First cut @ 60 DAS	14.00	5.83	187.17	99.15
C2: Second cut @ 85 DAS	12.92	5.17	183.67	92.33
C3: Third cut @ 110 DAS	11.58	4.92	188.17	92.71
S. Em±	0.24	0.14	0.97	0.27
CD (P=0.05)	0.71	0.42	2.83	0.80
INTERACTON (DXC)				
D1C0	10.67	3.67	90.67	47.15
D1C1	12.33	5.00	162.67	84.59
D1C2	11.00	5.00	151.33	78.87
D1C3	10.33	4.33	181.67	94.47
D2C0	12.33	4.67	155.67	80.95
D2C1	13.67	6.00	200.67	90.33
D2C2	14.33	5.00	194.00	88.00
D2C3	11.33	4.67	194.67	80.67
D3C0	11.33	4.33	132.67	68.99
D3C1	14.67	5.67	130.67	104.35
D3C2	13.33	5.00	189.67	98.63
D3C3	12.00	5.33	169.67	88.23
D4C0	14.33	5.33	200.67	104.35
D4C1	15.33	6.67	254.67	117.33
D4C2	13.00	5.67	199.67	103.83
D4C3	12.67	5.33	206.67	107.47
S. Em±	0.49	0.29	1.94	0.55
CD (P=0.05)	1.42	0.84	5.67	1.60
CV (%)	13.85	19.48	21.54	18.63

Asaadi *et al.* (2014) in alfalfa cv. Bam.

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TABLE 4
Effect of dates of sowing and cutting intervals on number of seeds per pod seed yield per plant, seeds yield per net plot and seed yield per hectare of alfalfa (Medicago sativa L.) Cv. RL-88

Treatment	No. of seed/pod	Seed yield (g/plant)	Seed yield (g net/plot)	Seed yield yield (kg/ha)
Dates of Sowing (D)				
D1: 1st July	4.50	0.953	102.35	222.52
D2: 15th July	5.08	0.997	107.44	236.79
D3: 1st August	6.67	1.185	127.32	280.59
D4: 15th August	6.50	1.351	146.13	322.00
S. Em±	0.11	0.004	0.02	2.07
CD (P=0.05)	0.37	0.014	0.06	7.18
Cutting intervals (C)				
C0: No cut	5.42	0.971	104.54	230.44
C1: First cut @ 60 DAS	5.92	1.265	136.40	297.51
C2: Second cut @ 85 DAS	5.67	1.168	126.15	278.02
C3: Third cut @ 110 DAS	5.75	1.082	116.16	255.93
S. Em±	0.08	0.003	0.02	1.86
CD (P=0.05)	0.22	0.010	0.05	5.42
INTERACTON (DXC)				
D1C0	4.33	0.717	77.08	170.08
D1C1	4.67	1.137	122.87	258.39
D1C2	4.67	1.009	108.87	239.94
D1C3	4.33	0.950	100.59	221.67
D2C0	3.67	0.845	90.22	198.83
D2C1	5.67	1.041	112.47	247.86
D2C2	5.67	1.061	114.63	252.62
D2C3	5.33	1.041	112.47	247.86
D3C0	6.67	1.041	112.47	247.86
D3C1	6.67	1.391	149.19	328.81
D3C2	6.67	1.231	132.99	293.09
D3C3	6.67	1.078	114.63	252.62
D4C0	7.00	1.281	138.39	305.00
D4C1	6.67	1.491	161.07	355.00
D4C2	5.67	1.371	148.11	326.43
D4C3	6.67	1.261	136.97	301.59
S. Em±	0.15	0.007	0.03	3.71
CD (P=0.05)	0.44	0.020	0.10	10.84
CV	20.18	18.003	18.23	19.29

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