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EFFECT DATES OF SOWING AND CUTTING INTERVALS ON SEED YIELD AND QUALITY OF ALFALFA (*MEDICAGO SATIVA* L.) cv. RL-88

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Abstract

A field experiment was carried to find out the effect of sowing dates and cutting intervals on seed yield and quality of alfalfa cv. RL-88. The results of the experiment revealed that significantly highest seed yield per plant (1.491 g), seed yield per plot (161.07 g) and seed yield (355.00 kg ha^{-1}) noticed in 15th August sowing and the cut at 60 days after sowing (D_4C_1). Similarly, the seed qualities *viz.*, highest seed germination (95.00%),seedling length (13.90 cm), seedling dry weight (412.69 mg) and seedling vigour index (1320) also recorded highest in15th August sowing and the cut at 60 days after sowing over others sowing dates and cutting interval.

Key words : Alfalfa, cutting intervals, seed germination, seedling vigour index.

Introduction

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.

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. 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 (Channakeshava, 2014).

Alfalfa has good production potential, but 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.

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Materials and Methods

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 2015-16. Field experiment laid out in split plot design with three replication with Gross plot size: 2.1 m × 2.0 m = 4.20 m^2 with spacing of 30 × 10 cm with 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.

The moisture content of seed was determined by the oven dry method as per ISTA Rules (2014). After drawing samples from different treatments, they were subjected to moisture determination immediately. At each stage of harvest, 10 pods were harvested and threshed separately. The seeds were dried at 103°C for 17 hours and then samples were taken out from the drying chamber, cooled to room temperature and their dry weight was recorded. From the primary data, moisture percentage in the seed was computed as detailed below

$$\text{Seed moisture (\%)} = \frac{\text{Fresh weight of the seed} - \text{dry weight of the seed}}{\text{Fresh weight of the seed}} \times 100$$

The pods from each treatment after harvest were hand shelled and seeds obtained were dried in the morning hours of sunlight, to bring down the initial seed moisture content to around 9 per cent. These seeds were subjected to laboratory observations.

The germination test was conducted in the laboratory using between paper method as per ISTA Rules (2014). One hundred seeds each of four replications were placed on germination paper and rolled towels were incubated in germination chamber maintained at 25°C and 90 per cent relative humidity. The germinated seedlings were evaluated on 5th and 14th day as first and final count and percentage germination was expressed based on normal seedlings.

The seedling vigour index was calculated as per the formula given by Abdul Baki and Anderson (1973).

Seedling vigour index = Germination (%) × Mean seedling length (cm).

Results and Discussion

The proper time for sowing determines forage yield of alfalfa crop. The optimum time of sowing of alfalfa depends upon the nature of variety and the temperature. Now-a-days, the high yielding varieties are most sensitive to time of sowing, hence, optimum time of sowing contributes more towards yield.

Effect of sowing dates and cutting intervals on seed yield of alfalfa cv. RL-88

The seed yield of alfalfa was significantly influenced by dates of sowing (table 1). The highest seed yield (322.00 kg ha^{-1}) was noticed in D_4: 15th August sown

Table 1 : Effect of dates of sowing and cutting intervals on seed yield per plant, seeds yield per net plot and seed yield per hectare of alfalfa (*Medicago sativa* L.) Cv. RL-88.

Treatments	Seed yield (g $plant^{-1}$)	Seeds yield (g net $plot^{-1}$)	Seed yield (kg ha^{-1})
D_1: 1st July	0.953	102.35	222.52
D_2: 15th July	0.997	107.44	236.79
D_3: 1st August	1.185	127.32	280.59
D_4: 15th August	1.351	146.13	322.00
S. Em±	**0.004**	**0.02**	**2.07**
CD (P=0.05)	**0.014**	**0.06**	**7.18**
C_0: No cut	0.971	104.54	230.44
C_1: First cut @ 60 DAS	1.265	136.40	297.51
C_2: Second cut @ 85 DAS	1.168	126.15	278.02
C_3: Third cut @ 110 DAS	1.082	116.16	255.93
S. Em±	**0.003**	**0.02**	**1.86**
CD (P=0.05)	**0.010**	**0.05**	**5.42**
D_1C_0	0.717	77.08	170.08
D_1C_1	1.137	122.87	258.39
D_1C_2	1.009	108.87	239.94
D_1C_3	0.950	100.59	221.67
D_2C_0	0.845	90.22	198.83
D_2C_1	1.041	112.47	247.86
D_2C_2	1.061	114.63	252.62
D_2C_3	1.041	112.47	247.86
D_3C_0	1.041	112.47	247.86
D_3C_1	1.391	149.19	328.81
D_3C_2	1.231	132.99	293.09
D_3C_3	1.078	114.63	252.62
D_4C_0	1.281	138.39	305.00
D_4C_1	1.491	161.07	355.00
D_4C_2	1.371	148.11	326.43
D_4C_3	1.261	136.97	301.59
S. Em ±	**0.007**	**0.03**	**3.71**
CD (P = 0.05)	**0.020**	**0.10**	**10.84**
CV	**18.003**	**18.23**	**19.29**

Table 2 : Effect of dates of sowing and cutting intervals on seed moisture content, seed germination, root length and shoot length of alfalfa (*Medicago sativa* L.) cv. RL-88.

Treatments	Seed moisture content (%)	Seed germination (%)	Root length (cm)	Shoot length (cm)
D_1: 1st July	7.71	89.00	5.50	6.53
D_2: 15th July	7.61	90.42	5.68	6.78
D_3: 1st August	7.44	91.75	5.90	6.97
D_4: 15th August	7.38	93.33	6.18	7.13
S. Em ±	**0.05**	**0.65**	**0.01**	**0.03**
CD (P=0.01)	**0.16**	**2.25**	**0.03**	**0.12**
C_0: No cut	7.86	89.83	5.65	6.54
C_1: First cut @ 60 DAS	7.27	92.92	6.15	7.14
C_2: Second cut @ 85 DAS	7.46	91.17	5.88	7.02
C_3: Third cut @ 110 DAS	7.56	90.58	5.58	6.72
S.Em ±	**0.04**	**0.37**	**0.01**	**0.02**
CD (P=0.01)	**0.12**	**1.09**	**0.03**	**0.05**
D_1C_0	8.02	87.00	5.40	6.03
D_1C_1	7.48	90.67	5.80	6.93
D_1C_2	7.67	89.33	5.50	6.70
D_1C_3	7.69	89.00	5.30	6.47
D_2C_0	8.00	89.00	5.50	6.53
D_2C_1	7.35	92.67	6.10	7.10
D_2C_2	7.46	90.33	5.70	6.93
D_2C_3	7.65	89.67	5.40	6.53
D_3C_0	7.61	90.67	5.60	6.73
D_3C_1	7.25	93.33	6.20	7.12
D_3C_2	7.37	92.00	6.10	7.20
D_3C_3	7.55	91.00	5.70	6.83
D_4C_0	7.83	92.67	6.10	6.87
D_4C_1	6.99	95.00	6.50	7.40
D_4C_2	7.33	93.00	6.20	7.23
D_4C_3	7.35	92.67	5.93	7.03
S. Em±	**0.08**	**0.75**	**0.01**	**0.04**
CD (P=0.01)	**0.25**	**2.18**	**0.03**	**0.10**
CV (%)	**4.64**	**2.65**	**7.36**	**8.92**

crop which is about 30.90 %, 26.46 % and 12.86 % reduction in D_1: 1st July (222.52 kg), D_2: 2nd July (236.79 kg) and D_3: 1st August (280.59 kg), respectively. The higher seed yield obtained in D_4: 15th August is mainly due to, maximum 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°C to 40°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, Gawariya *et al*. (2015) in forage mustard.

Similarly, the study revealed the cutting intervals also exhibited statically significant effect on various seed yield attributing and quality parameters.

The 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 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}), respectively. Initial period of cutting at 60 DAS recorded highest seed yield per plant (1.27 g) and seed yield per net plot (136.40 g). 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, greater number of fertile tillers, as well the seed yield per plant, which might have ultimately resulted higher yield per hectares. On the contrarily, the drastic and significant reduction in seed yield parameters in C_O (no cut) treatment. The increase in the number of cuttings caused severe depletion of starch and other food reserves affecting adversely the seed setting and seed weight per plant. These findings line in conformity with Bhatt *et al*. (2009) in forage grasses; Hadi *et al.* (2012) in barley.

The interaction effect between sowing dates and cutting intervals (D × C) revealed the marked variations on seed yield attributing parameters.

The highest seed yield (355.00 kg ha^{-1}) noticed in crop sown on 15th August with cutting imposed at 60 DAS fallowed by 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 yield per plant (1.49 g) and seed yield per net plot (161.07 g) at harvest was recorded in 15th August sown crop with cutting imposed 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 Suneetha Devi and Satyanarayana Rao (2007) in forage cowpea and Asaadi *et al.* (2014) in alfalfa cv. Bam.

Effect of sowing dates and cutting intervals on seed quality of alfalfa cv. RL-88

Significant variations in seed quality parameters were noticed due to different sowing dates (tables 2 and 3). The crop sown during August 15th (D_4) recorded highest seed germination (93.33 %), mean seedling length (13.31 cm), seedling dry weight (410.726 mg) and seedling vigour index (1242) and lowest seed moisture content (7.38%) as compared to other dates of sowing. This could be due to better source to sink relationship resulting better accumulation and assimilation of photosynthates. The early sown crop during 1st July gave lowest quality this could be due to stress conditions existed during growth, flowering (low abundance of pollinator activity in early sown crop, tripping per cent). The impact of flower abundance and pollinator movement on seed yield and quality is of economic importance. The hypothesis says

Table 3 : Effect of dates of sowing and cutting intervals on seedling length, seedling dry weight and seedling vigour index of alfalfa (*Medicago sativa* L.) cv. RL-88.

Treatments	Seedling length (cm)	Seedling dry weight (mg)	Seedling vigour index
Dates of sowings (D)			
D_1: 1st July	12.03	408.58	1073
D_2: 15th July	12.45	409.59	1127
D_3: 1st August	12.87	410.66	1181
D_4: 15th August	13.31	410.73	1242
S. Em±	**0.03**	**0.09**	**10**
CD (P=0.01)	**0.12**	**0.31**	**36**
Cutting intervals (C)			
C_0: No cut	12.19	408.96	1098
C_1: First cut @ 60 DAS	13.29	411.31	1235
C_2: Second cut @ 85 DAS	12.89	409.87	1176
C_3: Third cut @ 110 DAS	12.29	409.41	1114
S. Em±	**0.02**	**0.02**	**5**
CD (P=0.01)	**0.05**	**0.06**	**15**
D_1C_0	11.43	407.58	997
D_1C_1	12.73	410.33	1155
D_1C_2	12.20	408.28	1091
D_1C_3	11.77	408.16	1048
D_2C_0	12.04	408.02	1073
D_2C_1	13.20	410.96	1224
D_2C_2	12.63	409.88	1141
D_2C_3	11.93	409.50	1070
D_3C_0	12.33	410.07	1119
D_3C_1	13.32	411.26	1243
D_3C_2	13.30	410.79	1223
D_3C_3	12.53	410.51	1140
D_4C_0	12.97	410.19	1202
D_4C_1	13.90	412.69	1320
D_4C_2	13.43	410.54	1249
D_4C_3	12.93	409.48	1198
S. Em±	**0.04**	**0.04**	**10**
CD (P=0.01)	**0.10**	**0.13**	**29**
CV (%)	**7.87**	**0.33**	**8**

that seed set is lower when standing crop of open flowers is high than when standing crop is low. This could occur if pollinators move more among flowers on the same plant, causing self-pollination, when flowers are abundant (Stanisavljevic *et al*., 2012).

Similarly, the cutting intervals imposed found significant effect on seed quality attributes. Among the three cutting treatments, C_1 : cutting imposed at 60 DAS gave highest seed germination (92.92%), mean seedling length (13.29 cm), seedling dry weight (411.308 mg),seedling vigour index (1235) and lowest seed moisture content (7.27%), compared to other cutting intervals.

The interaction effect of sowing dates and cutting intervals shown marked variation in seed quality parameters of alfalfa.

The highest seed moisture content (8.02%) was recorded in D_1C_0 (1st July sown crop with no cut) and the lowest (6.99 %) was recorded in D_4C_1 (15th August sown crop + cutting interval @ 60 DAS). Similarly, the higher seed germination (95.00%), mean seedling length (11.90 cm), seedling dry weight (412.690 mg) and seedling vigour index (1320) recorded in 15th August sown crop + cutting interval @ 60 DAS was found minimum in D_1C_0: 1st July sown crop with no cut (87.00%, 11.43 cm, 407.58 mg and 997, respectively). These findings line in conformity with Rade *et al.* (2012) and Azizza and Babo (2013) in alfalfa.

Conclusion

The non-availability of good quality seed is one of the major constraints in popularizing the seed production practice for most of the forage crop species. Hence, the production and supply of high quality seeds of these crops at reasonable price is very much necessary. The experiment results revealed that, sowing crop during 15th August sowing with cut at 60 days after sowing resulted in significant increase in seed yield and quality of seeds of alfalfa.

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