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OPTIMIZING CUTTING INTERVALS TO EXPLOIT FORAGE AND SEED YIELD POTENCY OF CLOVER CULTIVARS

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Considering the demand for fodder and berseem (*Trifolium alexandrinum* L) seed in Pakistan current field study was carried out to evaluate the influence of cutting intervals on fodder production, seed vigor, yield and income of three berseem varieties. The experiment was conducted at research area of Fodder Research Institute Sargodha, Pakistan during three winter seasons from 2015 to 2018. Split plot design comprising three main plot treatments of berseem varieties i.e. super late, Agaiti berseem, Punjab berseem/SB11 and subplot treatments of five last cutting dates (i.e., March, 10, 20 & 30 and April, 10 & 20) was adopted with three replications. The results showed significant variations in the period of flowering and yield attributes. It was noted that quality and production of seed reduced while the fodder tonnage increased with delay in last cut for fodder, thus last cut taken on 20th April resulted in more number of cuts and significantly higher green fodder yield but low seed yield and total income. Last cutting of *Agaiti* berseem taken on 10th March, Super late & Punjab Berseem cut on 20th March produced significantly higher number of seeds per head, seed yield, 1000 grain weight and number of tillers-m^{-2}. It was concluded that all three varieties gave optimum production (0.73-0.95 T-ha^{-1}) of quality seed while taking the last cut between March, 10 & 20 with minimum temperature ranging from 8.66-22.33 ºC, maximum temperature ranging from 25.91-39.79 ℃ and relative humidity ranged from 46.30 to 64.40%.

Keywords: Berseem (*Trisodium alexandrinum* L.) production technology, Economics, Management of last cut Temperature, Quality attributes, Seed yield.

INTRODUCTION

A number of various fodder crops are grown around the world, amongst, berseem is the major legume fodder crop cultivated in south-east Asia because of its several qualities. It offers more vegetative growth, has multi-cut nature, better forage output, prolonged time of forage, prominent fodder yield with outstanding delicious and excessive beneficial value. It contains 20-21% crude protein and 62% total edible food (Yadav *et al*., 2015). It is the biggest beneficial winter forage crop cultivated on irrigated areas in Pakistan. Berseem is considered as "king of fodders" due to its highest tonnage capacity having no toxicity. It is used as green forage during the seasons as well as hay and pallets during off seasons (Nigam *et al*., 2010). This is mainly grown in the Punjab region, where small landholders spare only two to three hectares and main portion is utilized for cultivation of major crops (Cain *et al*., 2007; Dost *et al*., 2014). Livestock is the most important portion of farming pattern which, contributes approximately forty percent (40%) in annual income of small farmers. Livestock is indispensable for milk, meat and for work provisions (Anwar *et al*., 2012). Fodder crops cover 16 to 19 percent of cropped area as a total in Pakistan (Momina, 2018; Saeed *et al*., 2011). GOP (2015) reported that Clover as winter forage crop was cropped on 710,000 ha which produced approximately 22. 61 million tons of fresh fodder (dry herbage basis). Clover is cultivated alone as well as a mixed crop with oats and brassica spp. to improve the fodder yield and quality. It is also used with straw of wheat and rice to feed the animals (Ud-Din *et al*., 2014). Clover is mostly grown as multipurpose crop such as for hay, forage and grains, which are oftenly stored for sowing in next season (Dost *et al*., 2014). The fodder and seed yield of improved varieties are significantly higher as compared to those cultivated by the smallholder farmers (GOP, 2014). Berseem fodder is highly palatable due to its succulence and nutritious value, as it contains 20% crude protein and 62 % total digestible nutrients. Its vegetative and reproductive phase take place at the same time leading to deprived seed setting (Asmaa, 2017). Because of shortage of fodder in Pakistan, it is repeatedly cut for green forage, which leads to vigor loss and reducing of nutrients store for seed raw material (Singh, 1993). The success of each crop mainly depends on the availability of the quality seed which is the most critical input for the agriculture. Crop yield and biomass production is often enhanced by using quality seed. Seed yield in forage crop is generally low due to more vegetative growth as well as reduced seed setting (Yadav *et al*., 2015).

Berseem is generally sown during last week of September and three to four cuttings are taken till March, then crop is left for seed. Seed production depends on many factors, amongst, time of last cut for fodder is the most important for quality seed production. Normally last cutting is taken very late thus very short time is left for seed setting. Moreover, high air temperature and low humidity coincide with pollination and fertilization (Singh *et al*., 2019). Less bee activity also leads to poor pollination (Dixit, 1989, Yadav *et al*., 2015), pollens infertility, post fertilization, termination of seed development (Pasumarty *et al.*, 1993) which all result in weak seed setting. Low grain production having poor quality is because of lack of recommended technology for grain crop management and use of poor quality seed. Recent climate change in Pakistan have prolonged the warm season, shortened the rabi cool season and extended temperature in growing season of clover. So, it is very necessary to change the time of last cut when berseem is left for seed to avoid the high temperature effect on pollination and fertilization of berseem. Seed production of berseem is decreased by high temperature at procreative phase (lannucci and martiniello, 1998). Grain yield of clover mainly depends on weather conditions and activity of insects especially honey bee during the blooming span (Marliniello *et al*., 1999; Lannucci, 2001; Bakheit *et al*., 2012). El-Zanaty (2005) reported that berseem seed production significantly influenced by date of sowing, number of cuttings and highly by the last cutting date.

Farmers continuously take berseem cuttings up to 15th April due to shortage of fodder, which prompted into lower foliage retention, weak blossoming and less seed productivity. Low fodder production and lesser seed availability are the main factors which affect the livestock productivity in Pakistan. Increase in livestock production mainly depends on the sufficient quantity and quality of feed. In several developing countries like Pakistan, fodder production is mainly restricted by land dearth, inadequacy of standard seed (Tufail *et al*., 2017) and unawareness about fodder production technology and usage (Kamanzi and Mapiye, 2012). The quantity and quality of livestock feed can only be achieved when sufficient quantity and quality seed of fodder varieties are available.

Keeping in view the above situation of fodder and shortage of quality seed in the country, the current study was conducted to devise technology for production of quality seed by optimizing the last date of fodder cutting and to investigate the effect of temperature on yield of fodder as well as yield and quality of berseem seed.

MATERIALS AND METHOD

***Experimental Site*:** Current research study was conducted at farm area of Fodder Research Institute (FRI) Sargodha during five winter seasons of 2015 to 2018. The study area is characterized as extreme hot in summers and moderate cool in winters with maximum temperature of 50 °C (122 °F) in summer and minimum temperature sometimes drops to freezing point in the winter. Soils of the area are generally loam having organic matter 0.61% pH 7.85±-0.11, Nitrogen 0.06± 0.01, $^{+}$K174±6.34 mg-kg^{-1} and P 5.6±0.41.

Experimental design: The experiment was laid out in split plot design with varieties in main plot and cutting dates in sub plot with plot size 6 m x 3 m. The field was prepared with two ploughing and planking followed by one ploughing with rotavator. Sowing was done during the first week of October by broadcast method in standing water of each treatment. Three popular berseem varieties (v_s) namely *Agati Berseem* (v_1) S*uper late* (v_2) and *Punjab Berseem/SB11* (v_3) were selected and certified seed of all verities was sown at rate of 20 kg ha^{-1} with three replications. The treatments comprised of following five cutting dates (cd_s)

(1) Cutting date 1 (cd_1): 10th of March;
(2) Cutting date 2 (cd_2): 20th of March;
(3) Cutting date 3 (cd_3): 30th of March;
(4) Cutting date 4 (cd_4): 10th of April and
(5) Cutting date 5 (cd_5): 20th of April

Fertilizers comprising NPK were used @ 57-57-57 kg-ha^{-1}, with half nitrogen and full dose of Phosphorus & Potash at the time of soil preparation and rest of nitrogen was applied after 30 days of crop sowing by broadcast. All other cultural practices were kept uniform according to the recommendations of the agriculture department.

Cutting and data collection: First cutting of fodder was obtained after fifty to fifty-five (50-55) days of sowing from all the plots when crop achieved 55-60 cm height and last cut for fodder was managed according to treatments of the experiment. The maximum fodder cuts depend on last cutting date for fodder. After each cut fresh fodder yield per plot was measured by the spring balance. The crop was left for seed according to pre-defined dates after taking the last cut of fodder. The tillers-m^{-2} were recorded with the help of m^2 quadrate at the time of each cutting by taking two samples from each treatment. Pre-harvest observations on days to 50% blossoming, days to 100% flowering, days to maturity from date of sowing and date of last cut were taken. Post-harvest observations consisted of tillers-m^{-2} at maturity stage, seed per capsule, 1000 seed weight and seed yield. Seeds per capsule were counted by selecting 10 heads per treatment and 1000 grain weight recorded by taking three samples from each treatment. Per hectare income was estimated from fodder and seed yieldas per market rates (seed @ Rs 300 per kg and fodder @ Rs 100 per 40 kg).

Seed Germination: Seed germination was tested by taking samples of 100 seeds from each treatment date and sown in four replications during the next year using top of the paper method for 7 days. After taking germination data, seedlings were categorized into normal and abnormal seedlings. Germination was calculated from number of normal seedlings obtained out of total seed used for germination (Perry, 1978).

Seedlings' Dry Weight: Seedlings dry weight was recorded from four replications according to standard method (Gupta, 1993). Ten normal seedlings selected from germination test were weighed after drying at 100 °C for 24 h which had been kept in desiccators with silica gel before weighing.

Seed Vigor Index: Seed vigor index was calculated as per Perry (1978) by taking the product of germination percentage and seedling dry weight in grams.

Data Analysis Statistical analysis of data was carried out for various parameters including variance. Mean differences of the treatments were compared by the LSD test at 5% probability level according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The main as well as interactive effect of last cutting date and genotype on flowering and maturity in berseem was studied and found significant (means of three years) as given in Table 1. It was noted that highest number (223, 225 & 240) of days from sowing to 50 % blossoming, 100% blossoming and days to maturity respectively were recorded in treatment v_2*cd_5 (where v refers to variety and cd refers to cutting date) while minimum number of days (198, 205 and 228 days) were recorded in v_1*cd_1 (Table 1). Number of days recorded from date of last cut to 50%, 100% blossoming and seed maturity is reciprocally related to number of days taken for sowing to blossoming and seed maturity. The number of days to 50 % blossoming was reduced from 47 in v_2*cd_1 to 21 in v_2*cd_5 (Table 1).

Yield parameters

***Number of tillers m^{-2} of each cut*:** Number of cuttings for fodder and varieties as well as their interactive effect were also studied and found considerable influence on tillers m^{-2} (Table 2). It was observed that number of tillers consistently increased up to 3rd cut and after that decreased till the last cut. Maximum tillers (484 m^{-2}) were recorded at 3rd cut and minimum tillers (210 m^{-2}) were observed after final cut. Interactive influence of different varieties and last cutting date was also significant. Cultivars showed similar response to increase and decrease in number of tillers after each cutting. Maximum tillers were observed at 3rd cutting and minimum at the time of 6th cutting. Maximum tillers (510 m^{-2}) were

Table 1. Influence of interaction between last cutting date and genotype on flowering and maturity in berseem (Means of three years).

Treatment	Days to 50%flowering		Daysto100%flowering		Days to maturity	
Interaction	From sowing	From last cut	From sowing	From last cut	From sowing	From last cut
v_1 x cd_1	198.33I	37.33C	205.33J	44.33E	228.00H	66.00B
v_1 x cd_2	202.00HI	31.00D	210.33I	39.33F	229.67GH	58.33C
v_1 x cd_3	208.67FG	26.67E	213.67H	32.67I	232.33FG	51.33E
v_1 x cd_4	212.33DEF	20.00G	215.67G	23.66L	232.67EF	41.67G
v_1 x cd_5	217.33PC	15.33H	219.33DE	17.33N	234.33DEF	32.33I
v_2 x cd_1	211.33EFG	47.33A	215.33G	54.33A	238.00ABC	76.00A
v_2 x cd_2	212.33DEF	41.33B	220.33CD	49.33C	239.67AB	69.33B
v_2 x cd_3	214.33CDE	32.33D	219.67DE	38.67G	238.33ABC	57.33CD
v_2 x cd_4	218.67ABC	26.67E	221.67C	29.67J	239.67AB	47.67F
v_2 x cd_5	223.33A	21.33FG	225.33A	23.33L	240.00A	38.33G
v_3 x cd_1	206.33GH	45.33A	213.33H	52.33B	236.0CDE	74.33A
v_3 x cd_2	210.67EFG	39.67BC	218.33EF	47.33D	237.67A-D	66.33B
v_3 x cd_3	212.67DFF	30.67D	217.67F	36.67H	236.33B-E	55.33D
v_3 x cd_4	216.33B-E	24.33EF	219.67DF	27.67K	237.67A-D	45.67F
v_3 x cd_5	221.67AB	19.67G	223.33B	21.33M	238.33ABC	36.33H
LSD	5.4159	3.0691	1.4299	0.4766	3.3735	2.3797

Table 2. Influence of number of cuts, genotypes and their interactive effect on tillers m^{-2} of berseem (Pooled three-year data).

Treatments	V1	V2	V3	Means
No. of cut 1	389.00 EF	389.67 EF	272.67 FGH	386.78 C
No. of cut 2	456.67 BC	436.67 CD	443.33 CD	445.56 B
No. of cut 3	510.00A	483.00 AB	459.00 BC	484.00 A
No. of cut 4	415.67 DE	373.33 FGH	377.67 EFG	388.89 C
No. of cut 5	443.63 GHI	336.33 HI	333.67 I	337.89 D
No. of cut 6	211.67 J	211.67 J	206.67 J	210.00 E
Means	387.78 A	373.28 AB	365.50 B	

*LSD of varieties 19.232, LSD of number of cuts 21.481 and LSD of Interaction 38.748.

observed in v_1 at 3rd cutting date (cd_3) and minimum tillers (206 m^{-2}) were noted in v_3 at 5th cutting date (cd_5). Surinder *et al*., (2019) also reported "the maximum number of shoots m^{-2} on 25th March followed by 5th and 15th April cutting date".

Number of tillers at maturity stage m^{-2}: The combined effect of variety and last cutting date showed that cultivar v_1 produced highest number of tillers (525 m^{-2}) after first cutting date (10thMarch) which was statistically at par with second cutting date (20th March) of two cultivars (v_2 and v_3) showing 483 and 505 number of tillers respectively. After 5th cutting date (20th April) all cultivars showed non-significant response to number tillers (Table 3). Similar effects were recorded by Surinder *et al*., (2019) who noted maximum number of tillers in last cutting date of 25th March as compared to 5th and 15th April.

Number of grains capsule^{-1}: Maximum number of grains per capsule (60) were recorded from interactive effect of cultivar v_3*cd_1 (first cutting date, 10th March) which was statistically at par with v_3* cd_2 (second cutting date, 20th March), v_1*cd_1 and v_2*cd_1 (first cutting date, 10th March) Table 3. Minimum number of grains capsule^{-1} (34) was recorded from interaction of v_2*cd_5 and last cutting date (20th April) which was

Table 3. Interactive effect of berseem genotype and last cutting date on different parameters of berseem (Means of three years).

Treatment Interaction	No. of tillers at maturity	Grains capsule^{-1}	1000 grain weight(gm)	Germination %age	Vigor Index
v_1xcd_1	525.00A	57.00ABC	2.933AB	91.67A	1.292A
v_1xcd_2	467.67BC	54.00BCD	2.800BCD	91.00A	1.282AB
v_1xcd_3	385.00D	52.67CD	2.700DEF	86.67B	1.230AB
v_1xcd_4	271.67EF	42.33E	2.600F	78.33CDE	1.106D
v_1xcd_5	211.67G	45.00F	2.433G	71.33F	0.999E
v_2xcd_1	442.00C	55.00ABCD	2.767CDE	91.33A	1.283A
v_2xcd_2	483.33ABC	53.00CD	2.867ABC	90.33AB	1.274AB
v_2xcd_3	377.67D	50.67D	2.600F	88.00AB	1.243AB
v_2xcd_4	316.67E	43.67E	2.433G	79.33CD	1.201BC
v_2xcd_5	228.33FG	44.33F	2.267H	75.00EF	1.065DE
v_3xcd_1	484.00ABC	60.00A	2.867ABC	90.67AB	1.291A
v_3xcd_2	505.00AB	59.00AB	2.967A	89.67AB	1.279AB
v_3xcd_3	380.67D	52.67CD	2.633EF	87.67AB	1.251AB
v_3xcd_4	263.33EFG	42.67E	2.367GH	80.33C	1.141CD
v_3xcd_5	230.00FG	38.67EF	2.267H	76.00DE	1.074DE
LSD	54.64	2.44	0.137	3.8612	0.086

Table 4. Interactive effect of berseem genotypes and last cut date on income ha^{-1}, seed and fodder yield. (Means of three year)

Treatment Variety/Date	Fodder yield (t-ha^{-1})	Seed yield (t ha^{-1})	Income fodder (Rs. ha^{-1})	Income seed (Rs. ha^{-1})	Total income (Rs. ha^{-1})
v_1xcd_1	123.00H	0.9953A	307500G	288600A	606100AB
v_1xcd_2	131.67G	0.9167ABC	329175F	275000AB	604167AB
v_1xcd_3	139.10EF	0.7990BCD	347750E	239700BCD	587450ABC
v_1xcd_4	146.33CD	0.7317E	365825D	219500CD	585333ABC
v_1xcd_5	160.27B	0.3020F	402008B	90600E	493100D
v_2xcd_1	120.83H	0.8313B-E	302083GH	249400ABC	551438BCD
v_2xcd_2	137.20F	0.9163ABC	343000E	274900AB	617900A
v_2xcd_3	145.17D	0.7379DE	362917D	221900CD	584817ABC
v_2xcd_4	150.83C	0.6883E	377083C	206500D	583583ABC
v_2xcd_5	164.41AB	0.3577F	411025AB	107300E	518383CD
v_3xcd_1	118.73H	0.9017A-D	296825H	270500AB	567333ABC
v_3xcd_2	131.67G	0.9530AB	329175F	285900AB	615067AB
v_3xcd_3	137.33F	0.7577CDE	343325E	227300CD	570633ABC
v_3xcd_4	142.71DE	0.7000E	360100D	210000CD	570083ABC
v_3xcd_5	167.33A	0.3663F	418333A	109900E	528233CD
LSD	4.5316	0.1627	10005	47428	30284

statistically at par with v_3*cd_5 and v_1*cd_5 (last cutting date, 20th April). Similar findings were also given by Yadav *et al*., (2015); Din *et al*., (2014). The highest grains capsule^{-1} in cd_1 might be due to longer reproductive phase and a smaller number of cuttings for fodder, which resulted in higher production and transfer of photosynthates from source of sink (Surinder, 2019).

Thousand grain weight (g): In case of interaction of cultivar and date of last cut of fodder, maximum 1000 grain weight (2.967 g) was recorded from v_3*cd_2 that was statistically at par with v_1*cd_1, v_2*cd_2 and v_3*cd_3 (2.933, 2.867 and 2.867 g, respectively) as shown in Table 3. Minimum 1000 grains weight 2.267 g were noted from v_3* cd_5 and v_2*cd_5 which was statistically lower than v_1*cd_5 (2.433 g). The results revealed that detain in the forage cuttings decreased the 1000 grains weight and v_1 showed statistically less decrease in 1000 grains weight according to other both genotypes (v_2 and v_3). These results were supported by those of Sardana and Narwal (2000). The thousand grain weight reduction with delay in date of last cut for forage could be due to several factors i.e. weather parameters like temperature and photo period. The increase in highest and lowest temperature with delay in the last cut of fodder could be the cause for reduction in vegetative and reproductive stages and movement of pollinators. Similar findings were recorded by other workers (Singh and Kang, 2004; Pori *et al*., 2007; Yadav, 2015).

Seed germination and its vigor*:* The highest germination (92 %) was recorded from v_1*cd_1 which was statistically at par with v_2*cd_1, v_1*cd_2, v_3*cd_1, v_3*cd_2, and v_3*cd_3 having germination percentage 91, 91, 91, 90 and 88 respectively (Table 2). These results indicate that only v_3 cultivar significantly behave better for seed germination up to 30th March last cutting date as compared to other cultivars. All other interactions showed significant behavior for germination. This could be due to reduction in vegetative and reproductive stages period along with the rising of temperature after the 3rd fortnight of March and April. The seedling vigor was assessed in terms of vigor index. It was found that seedling dry weight was considerably effected with the delay in last cutting date of fodder except CD_1 and CD_2 which was statistically at par and presented highest vigor index (1.289 and 1.278) respectively. These results are supported by the study of Yadav *et al*. (2015); Sardana and Narwal (2000).

Date of last cut: The interactive effect of cultivar and last cutting date was also noted significant on fodder yield (Table 7). Highest fresh fodder yield (167.33 t ha^{-1}) was obtained from v_3*cd_5 which was statistically at par with v_2*cd_5 and followed by v_1*cd_5. Total fresh forage yield enhanced by each detain in date of last cut for fodder up to 20th April during three years. Sardana and Narwal (2000); Surinder (2019) also reported the similar findings.

Seed production**:** The interactive effect of cultivar and last cutting date also showed significant influence on seed yield (Table 4). The maximum grain yield 0.9953 t ha^{-1} was recorded in v_1*cd_1 which was statistically at par with v_1*cd_2, (0.9167 t ha^{-1}), v_2*cd_2 (0.9163 t ha^{-1}), v_3*cd_1 (0.9017 t ha^{-1}) and v_3*cd_2 (0.9530 t ha^{-1}) and minimum grains yield was obtained from v_1*cd_5 (0.3020 t ha^{-1}). Data indicated that grain yield was reduced continuously by delaying the last cutting of fodder. Similar results were presented by other workers (Sardana and Narwal, 2000)

Income per unit area/ ha^{-1}: Fodder is the main contributing product in economics of berseem crop. Date of last cut of fodder have significant influenced on income of berseem per unit area. Maximum income of fodder was achieved from cd_5 which was statistically similar to cd_4 (Table 5) and minimum income was obtained from cd_1. In case of seed, statistically higher income (Rs-278600 ha^{-1}) was observed from cd_2 which was statistically at par with the income (Rs-269500 ha^{-1}) of cd_1 however, minimum income (Rs-102600 ha^{-1}) was achieved from cd_5. Total income (seed + fodder) per unit area (Rs-612378 ha^{-1}) statistically higher was observed from cd_2 followed by cd_3 (Rs-580967 ha^{-1}), cd_4 (Rs-579667 ha^{-1}) and cd_1 (Rs-574972 ha^{-1}) and minimum income (Rs-513239 ha^{-1}) was obtained from cd_5. The last cut of fodder up to 3rd week of March provides sufficient time to have 3-4 cuts for fodder when crop was sown during 1st and 2nd week of October. This

Table 5. Weather parameters during last cutting dates for three growing seasons.

Season	Weather parameter	Standard metrological period coinciding with last cut											
		February			March			April			May		
		1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	Max. Temp. °C	21.19	21.30	27.57	27.40	23.70	30.73	32.07	35.80	38.10	36.85	39.60	39.12
	Mini. Temp °C	8.44	8.40	12.66	16.40	15.40	17.91	20.80	23.20	22.90	24.00	25.24	25.75
	R. Humidity %	68.04	67.40	60.02	64.50	72.15	51.02	51.50	38.12	30.80	48.88	44.22	45.32
2017	Max. Temp. °C	20.87	24.85	25.66	24.20	25.10	34.00	32.20	41.20	36.60	36.16	38.66	38.50
	Mini. Temp °C	10.10	12.50	10.80	14.10	12.00	20.45	19.40	23.50	23.00	24.00	25.55	27.12
	R. Humidity %	70.15	67.03	48.98	59.46	56.45	46.23	45.97	29.70	41.45	41.15	42.98	44.60
2018	Max. Temp. °C	23.33	22.50	25.25	27.70	30.70	32.18	33.50	33.20	38.30	34.00	35.33	41.77
	Mini. Temp °C	7.44	10.88	14.75	14.90	17.20	18.09	21.00	21.40	22.40	22.00	24.25	24.87
	R. Humidity %	55.02	61.38	63.11	57.97	49.52	48.42	52.47	49.00	38.45	48.97	44.80	26.14

means that the date of last cut of fodder up to 20th March can provide a balance between fodder yield and seed yield. These results are supported by Sardana and Narwal (2000) who found that "the maximum net return were achieved on the 2nd March last cut date for fodder followed by 1st April as last cut date and the 11th April as last cut date produced lowest net return".

***Conclusion*:** From the current study, it is concluded that seed yield attributes and income per unit area can be enhanced by delaying the last cutting date till 20th March. All three berseem varieties gave optimum yield of fodder and quality seed at temperatures ranged from 15 to 38^0C which was found the most favourable for completion of vegetative and reproductive phases successfully. Whereas the relative humidity ranged from 60.70 to 38.69 % was found the most feasible. Therefore, it is recommended that last cut of fodder must be completed between 2nd to 3rd week of March after which crop should be left for seed setting. Furthermore, the authors recommend to carry out further investigations to establish relationship between accumulation of photoperiods, appropriate temperature and time for flowering.

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