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Effect of Different Sowing Dates and Timings of Last Cut on Yield Attributes and Seed Yield of Berseem (*Trifolium alexandrinum* L.)

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ABSTRACT

Background: Many genetical, physiological, environmental and organizational constraints associated with the low productivity of forage crops, but the most important among them is lack of quality seeds of improved cultivars to farmers. Scarcity of green fodder and low seed setting forces the farmers not to prefer for seed production. Weather extremities like unbalanced or untimely rains or high speed winds also affected seed setting. All these extremities lead to scarcity of berseem seed in Punjab and farmer are forced to paying high prices at the time of sowing. Maintaining the proper sowing time and time of last cut for fodder and for leaving the crop for seed production may help in keeping the balance between vegetative and reproductive phases for high seed yield to tackle these problems. Therefore, optimum sowing time and last cut is a very deciding factor to achieve maximum green fodder and seed yield. The current experiment aimed to study the effect of different sowing dates and timings of last cut on yield attributes and seed yield of berseem (*Trifolium alexandrinum* L.).

Methods: In this experiment, crop was sown on five different dates with the broadcast method and also three dates of last cut of crop left for seed production. These treatments were replicated thrice. All other cultural practices were also maintained for optimum berseem productivity. The first cutting of fodder was taken after 55 days from sowing and thereafter 30 days interval. After the time of last cut, crop was left for seed production. At maturity, data on yield attributes were recorded.

Results: Our investigations revealed that late sown berseem increased the yield attributes and seed yield but decreased the green fodder yield. Therefore to get maximum seed production, it is suggested that late sown 20th October has the optimum date of sowing and optimum time for leave the crop is 25th March for seed production.

Key words: Berseem, Cut, Fodder, Seed yield, Sowing date.

INTRODUCTION

Berseem (*Trifolium alexandrinum* L.) is one of the most important tropical forage legume cultivated in India, Pakistan, Turkey, Egypt and other Mediterranean countries. India had the highest area under berseem with around 2 m ha followed by Egypt (1.1 m ha) and Pakistan (0.71 m ha) (Mohammad *et al*. 2014). Among fodder crops grown in India berseem believe to be the “king of fodders” because of its green succulent leaves, stem and its quick regeneration power. It enriches the soil by fixing atmospheric nitrogen and by adding organic matter in the soil (Pooniya *et al*. 2015). It also helps to control weed in rice-wheat crop rotation by continuous cuttings (Dass *et al*. 2016). In Punjab where berseem being predominant *rabi* fodder cultivated on 2.27 lakh ha^{-1} produced 213.3 lakh ton green fodder with average productivity of 95 t/ha (Anonymous 2017). Availability of green fodder is not sufficient to tap the full potential of milking animals. At the time of sowing good quality of seed not sufficiently available to farmers because of limited seed production farms. To meet the local demand, berseem seed is imported from Middle East countries especially Egypt.

Generally, farmers in Punjab and adjoining states are preferring more green fodder production as compared to seed production because of severe shortage of green fodder during the month of April to June (Choudhary and Suri 2014 and Pooniya *et al*. 2015). Therefore, they do not leave the crop for seed setting at optimum time of sowing, resulting very low seed setting. Sometimes untimely rains or high speed winds also negatively affect the seed setting. All these factors seemingly responsible for ever green scarcity of berseem seed in Punjab and farmer are forced to paying high prices at the time of sowing. So it is pertinent to sow the crop in staggered manner to extend the time of green

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fodder availability on the one hand and study the optimum time of last cut under different sowing times to obtain maximum seed setting without negatively affecting the green fodder on the other hand. Keeping in view the importance of sowing time in production of seed in berseem, the present study was conducted to investigate the effect of different sowing times and last cut on flowering and seed yield attributes of berseem.

MATERIALS AND METHODS

The field experiment was carried out during the *rabi* season from September to June of 2016-2017 and 2017-2018 at Khalsa College, Amritsar and the weekly mean meteorological data recorded during the crop season (September 2016-June 2018) is shown in Fig 1. The field was prepared by ploughing once with tractor drawn disc harrow and two times with cultivator followed each time by planking. Seed inoculation with *Rhizobium* culture (1.5 kg ha^{-1}) was done by mixing the seed with culture after that dried in shade (Bai *et al.* 2016a and 2016b). Seeds were sown @ 25 kg ha^{-1} with broadcasting in standing water. Nitrogen in the form of urea 54.3 kg ha^{-1} was applied in two splits. Half dose of nitrogen applied at sowing and remaining half nitrogen with the first irrigation. While whole of the phosphorus in the form of SSP 468.7 kg ha^{-1} were broadcast at the time of sowing. The crop was sown on five different dates as per treatments on 10th September, 20th September, 30th September, 10th October, 20th October with the broadcast method and three times of last cut were 25th March, 5th April and 15th April. Plot size was 4m x 4m (16 m^2). These treatments were replicated thrice in split plot design. All cultural practices were maintained for optimum berseem productivity. The first cutting of fodder was taken after 55 days from sowing and thereafter 30 days interval. The total number of fodder cuttings depended upon the sowing date and last cutting date (Table 1).

At each cutting of fodder, random samples were taken by quadrate and weighed immediately for fresh weight using standard procedure (Rana *et al*. 2014). After the time of last cut, crop was left for seed production. At maturity, data on yield attributes were recorded. Days taken to flowering and maturity recorded both from sowing and last cut. Average number of head per plant and number of seed per head calculated by randomly selected ten plants from each plot. Data regarding number of shoots meter square and head meter square was taken by placing one meter square quadrate at the time of maturity randomly in three different places from each treatment. The crop was harvested manually with sickle after maturity and tied in bundles with tag from each plot and left for sun-drying; then threshed, winnowed and the yield estimated on per ha basis using standard procedures (Choudhary 2013). All the data was statistically analyzed by analysis of variance using CPCS-I software developed by the Department of Mathematics and Statistic, PAU, Ludhiana.

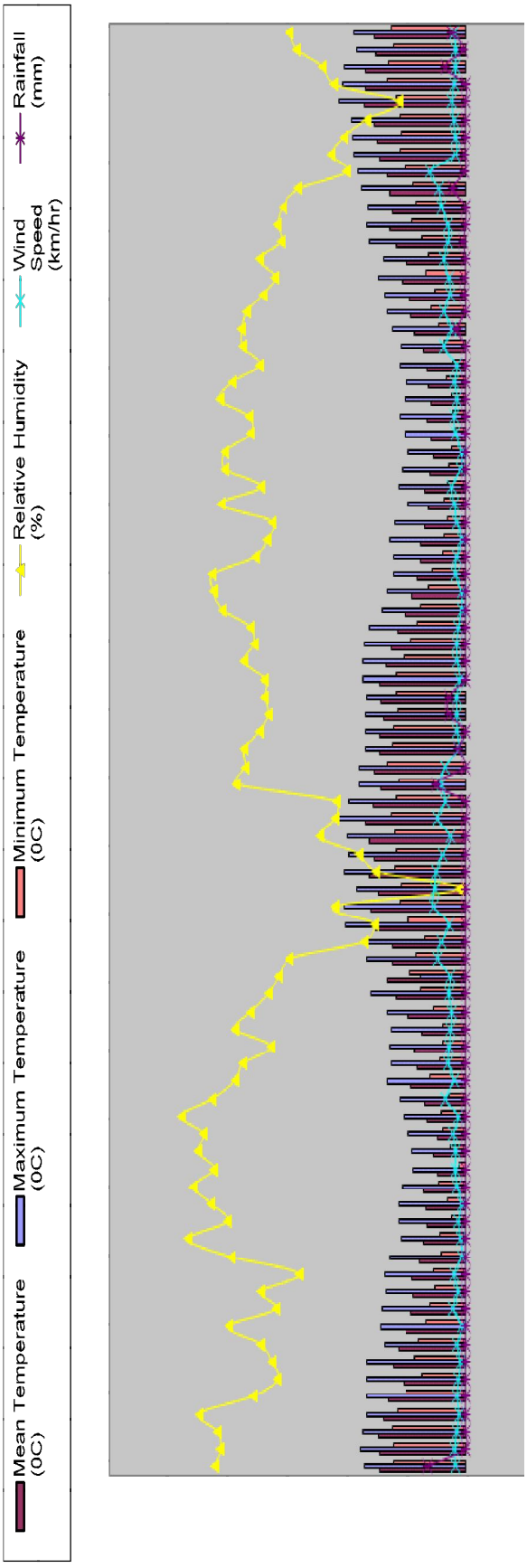


Fig 1: Weekly mean meteorological data recorded during the crop season (September 2016-June 2018).

RESULTS AND DISCUSSION

Green fodder yield

Date of sowing and timing of last cut had significant effect on green fodder yield (Table 3). Maximum green fodder yield (1129 q ha^{-1}) were obtained in early sowing (10th September), whereas minimum yield (751 q ha^{-1}) recorded in late sowing (20th October) (Table 3). Fodder yield decrease with delay in sowing mainly due to short vegetative period and lesser number of cuttings than early sowing. Similar results were also reported by (Sardana and Narwal 2000). Total green fodder yield continuously increased with each delay in last cut and availability more number of cuts in 15 April gave significantly higher fodder yield (1029 q ha^{-1}) than earlier cuts which shown in Table 3.

Days taken to 50% flowering

Date of sowing had significant effect on days taken to 50% flowering from sowing, but there was no significant variation when days counted from last cut (Table 2). The maximum days taken to 50% flowering were recorded in 10th September (226.9 days), whereas minimum days were recorded in 20th October (184.8 days). Flowering time flexibility is a commonly happening adaptive feature of fodder crops. Flowering time is primarily influenced by temperature, genotype and photoperiod (Suri and Choudhary 2013 and Bai *et al.* 2016a and 2016b). Time from sowing to flowering decreased as sowing was delayed which led to shorter growing season. The number of days taken to flowering were significantly more as the last cut delayed from 25th March to 15th April when counted from time of sowing. The number of days showed significantly decreasing trend from 25th March (26.8 days) to 15th April (18.8 days) when counted from last cut (Table 2). This might be due to more pronounced effect of increasing temperature during the last cut (Choudhary and Suri 2014).

Table 1: Effect of different sowing dates and time of last cut on the number of fodder cuttings.

Sowing time	Total number of foliage cutting		
	Time of last cut		
	25th March	05th April	15th April
10th September	6	6	6
20th September	5	6	6
30th September	5	5	6
10th October	5	5	5
20th October	4	5	5

Days taken to 100% flowering

Different sowing dates had significant effect on days taken to 100% flowering from sowing but there was no significant variation when days counted from last cut (Table 2). Maximum days taken to 100% flowering were recorded in 10th September both from sowing (235.5 days) and last cut (31.4 days), whereas minimum days were recorded in 20th October (193.0 and 29.5 days) (Table 2). Increase in temperature with longer photoperiod encourages early flowering and maturity irrespective of sowing time. Consequently, slightly decreasing trend in number of days counted from last cut to flowering. Number of days were significantly more as the last cut delayed from 25th March to 15th April when counted from time of sowing. On the other hand, number of days showed significantly decreasing trend from 25th March (36.3 days) to 15th April (25.5 days) when counted from last cut (Table 2). This change in trend might be due to more pronounced effect of increasing temperature during the last cut (Choudhary and Suri 2013 and 2014).

Days taken to maturity

Date of sowing and time of last cut had significant effect on days taken to maturity (Table 2). Maximum days taken to maturity from sowing was recorded in 10th September (270.1 days) while minimum observed in 20th October (225.7 days). Effect of days taken to maturity from last cut was found to be non-significant (Table 2). Minimum days taken to maturity in 20th October may be due to difference in physiological age, longer photoperiod and higher temperature during the

Table 2: Effect of different sowing dates and timings of last cut on days taken to 50% and 100% flowering and days taken to maturity of berseem from sowing and from last cut.

Treatments	Days taken to flowering				Days to taken Maturity	
	From sowing		From last cut		From	From
	50% flowering	100% flowering	50% flowering	100% flowering	sowing	last cut
Sowing dates						
10th September	226.9	235.5	23.5	31.4	270.1	65.5
20th September	216.7	225.1	22.9	31.0	258.9	64.3
30th September	205.9	214.6	22.1	30.5	251.4	63.7
10th October	195.7	204.2	21.9	30.1	237.1	62.5
20th October	184.8	193.0	20.0	29.5	225.7	61.3
CD(p=0.05)	2.9	3.3	NS	NS	8.2	NS
Timing of last cut						
25th March	200.6	210.4	26.8	36.3	244.5	70.1
5th April	204.8	213.9	20.9	29.7	247.5	63.1
15th April	212.6	219.2	18.8	25.5	253.6	57.2
CD(p=0.05)	2.2	2.49	2.5	2.5	5.1	5.1

Table 3: Effect of different sowing dates and timings of last cut on green fodder, yield attributes and seed yield of berseem.

Treatments	Green fodder yield (q ha^{-1})	Number of shoots m^2 at the time of maturity	Number of heads m^2 at the time of maturity	No of heads per shoot	No of seeds per head	Seed yield (q ha^{-1})
Sowing dates						
10th September	1129	187	627.1	3.22	36.2	3.63
20th September	1019	202	673.9	3.27	37.1	4.12
30th September	978	213	770.9	3.37	39.8	4.48
10th October	860	224	830.3	3.62	41.2	4.69
20th October	751	225	869.9	3.78	44.4	4.86
CD (p=0.05)	110	7.7	44.4	0.20	2.99	0.35
Timing of last cut						
25th March	876	218	776.9	3.79	42.2	4.57
5th April	949	211	753.8	3.52	40.5	4.36
15th April	1029	198	742.4	3.17	38.0	4.15
CD (p=0.05)	52.7	6.4	19.5	0.17	1.76	0.19

month of April which led to forced maturity (Yadav *et al.* 2015). Minimum days taken to maturity was recorded in 25th March (244.5 days) and maximum was recorded in 15th April (253.6 days), more number of days taken to maturity with delay in time of last cut may be due to longer period when counted from of sowing. Decrease in number of days significantly from 25th March (70.1 days) to 15th April (57.2 days) to maturity when counted from last cut may be due to more pronounced effect of increasing temperature and day length than physiological age which led to early maturity/ forced maturity (Yadav *et al.* 2015) (Table 2).

Number of shoots per m^2 at maturity

Number of shoots meter square varied significantly with the sowing time and last cutting dates (Table 3). Maximum number of shoots meter square was found maximum in 20th October (225) and minimum number of shoots per meter square observed in 10th September (187). The number of shoots meter square in case of last cut was found maximum in 25th March (218) and minimum in 15th April (198) (Table 3). Number of shoots decreased with delay in last cutting may be due to depletion of food reserves (Kumar *et al.* 2015).

Number of head m^2 at maturity

Date of sowing had significant effect on number of seed heads per meter square (Table 3).Maximum number of head per meter square was observed in 20th October (869.9) (Table 3). Delayed sowing increase the number of head per meter square as compare to early sowing. Bakheit *et al.* (2012) also reported that October sowing produce higher number of heads.Time of last cut had significant effect on the head per meter square, maximum head meter square was observed in 25th March (766.9) and minimum observed in delayed last cut which was 15th April (742.4) (Table 3). Due to the greater number of fodder cuttings with early sowing, regeneration of crop and floral buds adversely affected (Yadav *et al.* 2015).

Number of heads per shoot

Different sowing dates and time of last cut had significant effect on number of heads per shoot (Table 3). In berseem, flowering occurs in flushes and early flushes contains maximum numbers of flower heads. While later flushes have decreased number of flower heads (Yadav *et al.* 2015). Maximum number of heads per shoot was found in 20th October (3.78) whereas minimum number of heads per shoot in 10th September (3.22) might be due to more number of fodder cuttings from early sowing resulted in negative effect on regeneration potential of floral buds. Among the time of last cut, 25th March had maximum number of heads per shoot (3.79) whereas 15th April (3.17) had minimum number of heads per shoot (Table 3). The decrease in number of heads per shoot might be due to increased temperature with delay in last cut (Yadav *et al.* 2015).

Number of seeds per head

Maximum number of seeds per head were observed in 20th October (44.4) and minimum number of seeds per head were observed in 10th September (36.2) (Table 3). The increase in number of seeds per head with delayed sowings might be due to fewer fodder cuttings (Yadav *et al.* 2015).The time of last foliage cut affected number of seeds per head significantly. Maximum number of seeds per head was recorded with 25th March (42.2) whereas 15th April (38.0) had minimum number of seeds per head (Table 3). Decrease in number of seeds/head might be due to high prevailing temperature at maturity (Srivastava 2016). The increased temperature not only affects the bees activity but also reduced pollen fertility resulting in reduced seed setting (Bakheit *et al.* 2012).

Seed yield

Seed yield was significantly affected by time of sowing and time of last cut (Table 3). Maximum seed yield was recorded with 20th October (4.86 q ha^{-1}) whereas minimum seed yield was observed in 10th September (3.63 q ha^{-1}) (Table 3).

Maximum seed yield might be due to the cumulative effect of physiologically younger plants and optimum exposure of growing period with favourable climatic conditions which gave higher number of heads per shoot and number of seed head per plant (Sardana and Narwal 2000). It means higher seed yield comes with delayed sowing. Virendra *et al.* (2000) also observed increased seed yield of Egyptian clovers with delay in sowing. Among different time of last cut, treatment 25th March was recorded with maximum seed yield of 4.57 q ha^{-1} and minimum seed yield 4.15 q ha^{-1} was observed in 15th April (Table 3). Higher seed yield in 25th March might be due to fewer fodder cuttings which in turn resulted in better production and translocation of photosynthates from source to sink (Choudhary *et al*. 2014 and Srivastava 2016). Low seed yield indicated negative effect of frequent foliage cuttings.

CONCLUSION

Late sowing of berseem increased the yield attributes and seed yield as compare to early sowing (10th September) but green fodder yield decreased with delayed sowing. To get maximum seed production, it is suggested that 20th October has the optimum date of sowing and optimum time for leave the crop 25th March for seed production.

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