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Effect of time of sowing and last cut on green fodder and seed production in Berseem (*Trifolium alexandrinum* L.)

Surinder, Kanwaljit and Tarandeep

Abstract
The experiment was carried out at the Students' Research Farm, Khalsa College, Amritsar during the *Rabi* season 2017-2018. The field was laid out in split plot design comprising five main plot treatments of time of sowings i.e. 10th September (D_1), 20th September (D_2), 30th September (D_3), 10th October (D_4), 20th October (D_5) and three sub plot treatments of three last cutting dates *viz*., 25th March (C_1), 5th April (C_2) and 15th April (C_3) replicated thrice. The soil of experimental field was sandy loam in texture with normal pH and electrical conductivity. Soil rated medium in organic carbon, low in available nitrogen and medium in available phosphorus and potassium. Among different sowing time, maximum plant height, green and dry fodder yield significantly higher in 10th September whereas number of heads per shoot, number of seeds per head, seed yield and straw yield was significantly higher in 20th October. However in 20th October sowing days taken to flowering and maturity were significantly less. Time of last cut 15th April gave significantly higher plant height, green and dry fodder yield whereas 25th March produced significantly higher number of heads per shoot, number of seeds per head, seed yield and straw yield. Days taken to flowering and maturity from last cut was recorded significantly minimum in 15th April. Test weight, number of shoots and harvest index vary non-significantly throughout the treatments.

Keywords: Berseem, cut, fodder, seed, sowing time, *Trifolium alexandrinum* L.

Introduction
Berseem (*Trifolium alexandrinum* L.) is one of the most important rabi legume fodder crops grown under irrigated conditions occupying maximum area during winter season in India (Hazra, 1995). Berseem is cultivated on 20 lakh hactares and recorded production of green fodder is 60 to 110 ton per hectare in India Anon (2017) [1]. It is known as "king of fodders" because of its highest green fodder producing capacity among fodders. Berseem has no anti-nutritional and toxic effects. It is mostly used as green forage, but in off season it is also used in the form of hay and pallets etc (Nigam *et al.* 2010) [7].
Sowing of berseem is generally delayed due to late harvesting of rice in Punjab. Therefore, sowing from first week of September (after non rice crops to first week of November (after coarse rice) may help in regulating the green fodder on one hand and seed production on the other hand. Farmers continues fodder cutting till late March to mid-April which results into low foliage retention, poor flowering and thus low seed production. Seed production of berseem is also low because of the fact that farmers pay less attention to seed production causing serious seed shortage, temperature, relative humidity prevailing during the reproduction phases (Bakheit *et al.* 2012) [2]. The present study was taken up to find out the effect of time of sowing and last on green fodder and seed yield.

Materials and Methods
Site and Sowing Information: Field experiment was carried out during the winter season from September to April of2017-2018 at Khalsa College, Amritsar. Certified seeds of BL-1 variety used for sowing. The field was prepared by ploughing once with tractor drawn disc harrow and two times with cultivator followed each time by planking. Seed was sown at the

rate of 25 kg/ha with broadcasting in standing water. The soil of experimental filed was sandy loam, slightly alkaline (pH 7.7), medium in organic carbon (0.46%), low in available nitrogen (168kg/ha) and high in available phosphorus (28.5kg/ha) in the 0-15 cm soil layer.

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 cut was 25th March, 5th April and 15th April. These treatment were replicated thrice in split plot design with sowing times in main plot and time of last cut in subplot. The plot size was 3.60m*3.60m. Apply 25 kg nitrogen and 75 kg P_2O_5/ha. All cultural practices were maintained for optimum berseem productivity. The first cutting of fodder taking after 55 days from sowing. The total number of fodder cuttings depended upon the sowing time and time of last cut. At each cutting of fodder, random samples were taken from quadrat of 25*25 cm area, weighed immediately for fresh weight and dried, first in the shade and then in an oven at 65° C until constant weight was obtained. At each cutting, green fodder per plot was weighed for calculating the green fodder yield per hectare. Ten plants were randomly selected and measured the total number of shoot per plant and plant height from base of the plant and apex of the main shoot immediately before each cut.

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. Number of shoots meter square after the last cut were recorded randomly with the help of quadrat. Average number of head per plant and number of seed per head calculated by randomly selected ten plant from each plot. After threshing the crop 1000 seeds were taken at random from the bulk seed lot and their weight was recorded. All the data except days taken to emergence and emergence meter square were statically analysed by analysis of variance using a split plot design with times if sowing in main plot and time of last cut in sub main plots. The days taken to emergence and emergence meter square were analysis by randomized block design. Various cost involve in the cultivation of berseem and income from fodder, seed and straw were calculated.

Results

Time of sowing

Days taken to emergence and plant population

The time of sowing had significant effect on days taken to emergence. Minimum days taken to emergence 8.66 when crop sowing at 10th September and maximum days taken to emergence counted 12.77 when sowing done at 20th October. The results were agreement with Brar (1986) [3] Plant population is an important growth parameter. An optimum plant population is necessary to have better crop stand and yield. The plant population counted from 5th day of sowing to till 100% emergence. The data in Table 1 revealed that maximum plant population per square meter was recorded in treatment D_3 (392days). However, all the dates of sowings were statistically at par with each other.

Table 1: Effect of time of sowing and last cut on growth parameter of berseem.

Time of sowing	Days taken to emergence	Emergence (m^{-2})	Average plant height	Average number of shoots
10 September	8.66	376	58.6	6.65
20 September	10.61	287	57.8	6.81
30 September	11.44	392	55.8	7.12
10 October	12.33	384	55.0	6.99
20 October	12.77	379	46.1	6.93
CD=0.05	1.02	NS	4.6	NS
Time of last cut				
25 March	-	-	53.4	6.87
5 April	-	-	54.3	6.90
15 April	-	-	56.2	6.86
CD=0.05			22.0	NS

Growth Parameters

Plant height

The Table 1 illustrated that the time of sowings influenced plant height significantly. Maximum plant height was recorded in the 10th September (58.6) and minimum plant height was recorded in 20th October (46.1cm) might be due to low temperature during early vegetative growth stage (Taneja *et al.*, 1987) [13]. In case of last date of cut maximum height was obtained in 15 april.

Number of shoots per plant

Maximum number of shoots per plant was recorded in 30th September (7.12) and minimum in 10th September (6.65).Higher numbers of shoots in 30th September might be due to favourable temperature conditions. However, all the treatments were found statistically non-significant.

Yield Attributes

Fodder yield

The Table 2 revealed that the fodder yields decreased with delay in sowing from 10th September to 20th October. In 2017-2018, total green and dry fodder yields in the September sown crop were significantly higher than the October sown crop. Delaying sowing dates decreased fresh and dry forage yield (Ramadan *et al.*, 1994). Forage yields decreased with delay sowing mainly due to the shoter duration of the production season in the later sowings, and hence less number of cuttings were taken relative to early sowing (Brar, 1986; Taneja *et al.*, 1987; Singh, 1979; Rana *et al.* 1992 and Sardana and Narwal 2000) [3, 13, 8, 9]. More numbers of cuttings gave higher green fodder yield. Availability of more numbers of cuts due to longer growing period in 10th September (205), 20th September (195), 30th September (185), 20th October (175), 10th October (165days). Maximum green fodder obtained from 10th September (1161q/ha).

Time of sowing had significant effect on dry forage yield. Maximum dry forage yield was recorded in early sowing 10th September (165q/ha) and minimum yield obtained from delayed sowing 20th October (Ramadan *et al.*, 1994 and Sardana and Narwal 2000) [9].

Time of last cut for fodder

Among three time of last cut, 25 March showed significantly higher green fodder yield (1057q/ha) than C_2 (977) and C_1

(1057). Percent increase was 16.9 and 8.1 with C_3 and C_2 over C_1, respectively. More number of total cuts in C_3 and C_2 might be the reason for the higher yield thanC_1 (Sardana and Narwal, 2000) [9].

Among three time of last cut, C_3 showed significantly higher dry fodder yield (136q/ha) than C_2 (125) and C_1 (114). Percent increase was 19.2 and 9.6 with C_3 and C_2 over C_1, respectively. More number of cuts in C_3 and C_2 might be the reason for the higher yield thanC_1 (Deore and Desai, 1983).

Seed Yield

Time of sowing

The results in the Table 2 showed that the number of shoots meter square was found maximum in D_5 followed by D_4, D_3, D_2 and D_1. The minimum number of shoots meter square D_1 might be due to more number of fodder cuttings from early sowing results in negative effect on regeneration potential of floral buds (Singh *et al.*, 1980) [11].

Maximum seed yield was recorded with D_5 (4.95q/ha) whereas minimum seed yield was observed in D_1 (3.72q/ha). Maximum seed yield might be due to the cumulative effect of physiologically younger plants and optimum exposure of growing period with favourable climatic conditions (Sardana and Narwal, 2000) [9].

Time of last cut

The number of shoots meter square was found maximum in 25 march followed by 5 april and 15 april. Among different time of last cut, treatment $C_1$was recorded with maximum seed yield of 4.66q/ha and minimum seed yield was observed in C_3 (4.24q/ha) The higher seed yield in C_1 might be due to fewer fodder cuttings which in turn resulted in better production and translocation of photosynthates from source to sink (Singh, 1993) [12].

Table 2: Effect of time of sowing and last cut on yield parameter of berseem

Treatments	Green forage yield (q/ha)	Dry forage yield (q/ha)	Shoot (m^{-2})	Seed yield (q/ha)
Sowing time				
10 September	1161	165	190	3.72
20 September	1051	138	205	4.21
30 September	1010	124	216	4.57
10 October	892	107	227	4.78
20 October	783	91	228	4.95
CD=0.05	110	38	7.7	0.35
Time of last cut				
25 March	904	114	221	4.66
5 April	977	125	214	4.45
15 April	1057	136	202	4.24
CD=0.05	52.7	7.4	6.4	0.19

Time of sowing * time of last cut for fodder

Seed yield increased with delay the time of sowing from 10 September to 20 October and last sowing time 20 October gave maximum seed yield when leave the crop for seed production on 25 March. Seed yield progressively decreased with further delay in taking the last cut for fodder. Egyptian clover sown on 10 September and given its last cut for fodder on 15 April produced the lowest seed yield.

Discussion

Fodder yield decrease with delay in sowing mainly due to the duration of vegetative phase in the later sowing and hence lesser number of fodder cuttings taken than in the early sowing. In the September sown crop, 5-6 cuttings (depending upon the time of last cut for fodder) were given while in the October sowing 4-5 were taken. Total green and dry fodder yield continuously increased with each delay in last cut and availability of more number of cuts shown in Table 2 might be due to longer growing period in D_1 (205 days) than D_2 (195), D_3 (185), D_4 (175) and D_5 (165). Similar results were also reported by Sardana and Narwal (2000) [9].

As with the fodder yield, overall improvement in the growth and yield attributes resulted in higher seed yield**.** Seed yield progressively increased with delay in sowing in Table 2**.** Moreover, delay in sowing increase the number of shoots meter square and seed yield as compare to early time of sowing (Singh *et al.*, 1980; Taneja *et al.*, 1987) [11, 13]. Maximum seed yield might be due to the cumulative effect of physiologically younger plants and optimum exposure of growing period with favourable climatic conditions (Sardana and Narwal, 2000) [9]. Singh (1993) [12] believed that fewer fodder cuttings resulted in higher seed yield owing to the availability of food reserves for regeneration and seed development. Fewer fodder cuttings which in turn resulted in better production and translocation of photosynthates from source to sink (Singh, 1993 and Uppal *et al.* 1991) [12, 15] also reported decreased seed yield with delay in last cut.

Seed yield increased with delay in time of sowing and decreased with delay in time of last cut. The yield of multicut forages depending upon cutting managements (Dennis *et al.*, 1959) [5]. The number of shoots per plant decrease with increase in fodder cuttings (Tawfiq and Mohamed 1976). Abuu-Shakra *et al.* (1977) observed that number of branches and plant height decrease with delay in last cutting due to depletion of food reserves.

Conclusion

It was concluded that maximum green fodder yield and seed yield was recorded in early sowing (D_1) and late sowing (D_5) crop (Berseem BL-1) respectively. To harness the maximum benefits of dual purpose crop, it is suggested that 30th September has the optimum time of sowing. On the other hand 25th march is the optimum time of last cut.

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