Forage Res., **45** (2) : pp. 146-150 (2019) **http://forageresearch.in**

EFFECT OF DATE OF SOWING AND CUTTING MANAGEMENT ON FODDER PRODUCTION OF LATE SOWN BERSEEM (*TRIFOLIUM ALEXANDRINUM* L.)

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(Received : 12 August 2019; Accepted : 30 August 2019)

SUMMARY

The field on berseem crop was laid out in split plot design with fifteen treatments and three replications at Department of Agronomy, Khalsa College, Amritsar (Punjab). Four dates of sowing i.e. D_1:5 November, D_2:15 November, D_3:25 November, D_4:5 December and D_5: 15 December comprised main plots, whereas sub plot treatment consisted of three last cutting dates C_1:5 April, C_2: 15 April and C_3: 25 April. Sowing the berseem crop on Nov 5 (D_1) resulted in significantly higher plant height (51.7 cm), dry matter accumulation (11.1 t/ha) and green fodder yield (79.3 t/ha) than other sowing dates. Maximum B:C ratio (2.81) was observed with D_1 treament followed by other sowing treatments. Among the last cutting treatments, the treatment C_3 (25 April) gave the highest plant height (46.8 cm), dry matter accumulation (8.83 t/ha) and green fodder yield (69.1 t/ha) and it was significantly higher than other treatments. B:C ratio was found to the highest (2.84) with C_1 treatment

Key words : Berseem, inorganic fertilizers, soil health and fertilizers

Berseem (*Trifolium alexandrium* L.) also known as Egyptian clover is an annual pasture legume originated in Eastern Mediterranean regions. Fodder production in Punjab has to be substantially increased to feed 81.2 lakh livestock of which 62.4 lakh adult units to be provided with sufficient good quality fodder. The area under fodder crops in the state is approximately 8.7 lakh hectares (3.47 lakh hectares in *rabi* season) and the annual production is about 679 lakh tonnes of green fodder (Anonymous 2017). In Punjab, the availability of green fodder supply is quite low (29.8 kg/Animal/day) as compare to recommended supply of green fodder (40 kg green fodder per adult animal per day). As per future projection of fodder are very high *i.e.* 911 lakh tonnes of fodder will be required to meet the green fodder requirement to animals. To achieve this there is need to increase area and production per unit land per unit time by adopting better agronomic practices. Careful selection of ideal sowing time to take maximum advantage of environmental conditions during growth of berseem may help in increasing yield. Sufficient time is required after fodder cutting for optimum vegetative growth, attainment of bloom, pollination and seed setting. Growing of berseem as a seed crop is possible by sowing it in the beginning of January with less fodder yield. The time of last fodder cut after which crop should be left for seed production is another crucial factor for enhancing green fodder yield. The last cut for fodder should be timed in such a way that blooming development stages coincide with the favourable weather conditions which may be decided by manipulation of suitable date of sowing and last cut management. Keeping the above view in consideration, the present study was conducted.

MATERIALS AND METHODS

The field was laid out in split plot design with fifteen treatments and three replications. Five dates of sowing *i.e.* D_1:5 November, D_2:15 November, D_3:25 November, D_4:5 December and D_5:15 December comprised main plots, whereas sub plot treatment consisted of three last cutting dates C_1:5 April, C_2:15 April and C_3: 25 April. The soil of the experimental field was sandy loam in texture with normal pH (7.82) and electrical conductivity (0.26).Soil rated medium in organic carbon (0.47), low in available nitrogen (203.70) and medium in available phosphorus (18.23) and potassium (295.50). Gross plot size was kept as 4 m x 4 m and the net plot was kept as 3.6 m x 3.6 m. The meteorological data of Amritsar city recorded during the crop growth season in year 2016-17 has been presented in Fig. 1. Maximum temperature

Standard Week	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)	Relative Humidity (%)	Wind Speed (km/h)	Rainfall (mm)
41	27.1	34.5	20.9	75.1	2.7	0
42	25.4	34.3	18.5	71.8	3.0	0
43	23.0	32.6	16.2	73.0	2.3	0
44	20.5	28.4	14.8	82.4	1.3	0
45	18.1	26.6	12.5	85.4	1.3	0
46	16.3	24.5	11.2	85.7	3.4	0
47	14.7	24.2	7.5	71.3	3.0	0
48	15.0	25.5	7.1	67.3	1.2	0
49	13.7	24.0	5.8	65.4	3.0	0
50	12.4	19.2	7.1	82.9	3.6	0
51	13.6	22.7	5.7	69.4	4.6	0
52	11.9	21.4	5.3	81.4	1.6	0
1	10.5	19.2	4.6	81.4	1.3	0
2	11.5	20.3	3.2	72.9	3.3	0
3	12.6	22.1	4.2	73.3	3.8	0
4	11.4	20.3	4.8	83.4	2.7	0
5	12.5	19.6	6.4	78.7	3.7	0
6	12.6	22.1	4.3	69.7	2.9	0
7	14.2	21.6	7.3	75.4	7.3	0
8	17.1	24.8	8.7	75.7	4.4	2.84
9	18.4	26.7	11.5	74.1	7.1	0.00
10	18.7	27.2	10.3	68.7	5.2	0.22
11	21.2	29.3	13.1	64.7	5.6	0.11
12	19.7	27.7	12.4	70.0	7.3	0.00
13	23.4	32.4	14.6	62.6	5.7	0.62
14	25.5	33.4	17.8	63.7	5.8	0.00
15	24.7	32.8	16.6	61.9	8.0	0.07
16	25.7	35.1	17.6	56.4	8.9	4.32
17	26.4	36.2	20.5	40.2	11.7	0.15
18	28.9	37.7	22.0	45.2	3.4	0.14
19	30.0	38.2	21.7	41.1	3.4	0.07
20	31.0	38.6	22.4	33.4	3.9	0.03
21	34.4	43.0	23.6	22.7	4.5	0.0
22	33.8	41.4	26.3	44.4	3.8	0.0
23	33.7	41.2	26.2	48.4	3.2	6.85
24	30.2	36.8	24.5	57.0	3.2	0.58
25	30.6	37.6	25.2	59.7	3.9	4.75

Fig. 1. Mean weekly meteorological data recorded during the crop season (October 2017- June 2018).

ranged between 19.2^0 and 35.1^{0}C while minimum temperature ranged between 3.2^0 and 20.9^{0}C. Maximum temperature 43.0^{0}C was recorded in the 21th week in May and minimum temperature 3.2^{0}C was recorded in 2nd week in January. While, the maximum relative humidity 85.7 per cent was recorded in 46th week in November and minimum relative humidity 22.7 per cent was recorded in 21th week in May. Moreover, maximum precipitation 6.85 mm was recorded in the 23th week in June. Maximum wind speed 11.7 km per hour was recorded in the 17th week in April and minimum wind speed 1.2 km per hour was recorded in the 48th week in November.

RESULTS AND DISCUSSION

Emergence count per square meter

A good and uniform emergence is the basic requirement for a better establishment that is essential for the successful raising of any crop, which ultimately determines the crop yield. Data presented in Table 1 indicate that date of sowing have significant effect on emergence count. The highest emergence of 390.1 per m^2 was found under 5th November sowing whereas the minimum of 338.2 per m^2 was recorded on 15th December sowing date. The possible reason for lower

emergence count under late sown conditions can be ascribed to the fact that the temperature remained low in month of December (Table 1). All interactions were found to be non significant.

Days taken to emergence

The data depicted in Table 1 indicated that date of sowing had significant effect on days taken to emergence. Delay in sowing caused significant increase in number of days taken to emergence. The data also brings out that the days to emergence increases from 9.49 to 15.8 as the sowing was delayed from November 5 to December 15. The results are in agreement with the findings of Brar (1981). All interactions were found to be non significant.

Plant height

The data presented in Table 1 indicates that plant height varied significantly under the influence of date sowing. The plant height at 55 and 85 DAS were observed to be significantly highest on 5 November date of sowing and lowest at 15 December sowing date. At 115 DAS, the highest plant height were observed in treatment D_5 (70.5) and lowest at treatment D_3 (61.5). It was observed that crop sown on November 5 recorded the highest mean plant height (of 55, 85, 115, 145 and 175 DAS) and each delay in sowing from November 5 to December 15 caused significant decline in plant height. This decline in plant height may be due to the prevalence of low temperature throughout the life cycle late sown of crop. The results were in agreement with the findings of Taneja *et al*. (1987).

The plant height at 55, 85 and 115 DAS did not varied significantly at last cutting dates. But on other hand the mean plant height, due to last cutting date of 25th April, caused delay in last cutting of berseem which caused significant and consistent increase in plant height. This increase in mean plant height of crop due to later cutting date can be attributed to the availability of more time to regenerate after its previous cut. The results were in agreement with findings of Sardana and Narwal (2000). All interactions were found to be non significant.

Number of tillers per plant

The data depicted in Table 1 showed that tillers number per plant did not vary varied significantly due to date of sowing and date of last cut. All interactions were found to be non significant.

Dry matter accumulation

The data presented in Table 1 revealed that date of sowing caused significant variation on dry matter accumulation. The dry matter accumulation at 55 and 85 DAS was observed to be significantly highest on 5 November date of sowing. At 115 DAS, the highest dry matter accumulation was observed in treatment D_5 (2.86 t/ha) and lowest at treatment D_2 (2.29 t/ha).On other hand the first date of sowing

TABLE 1
Effect of date of sowing and cutting management on growth parameters of late sown berseem

Treatments	Emergence count/m²	Emergence (days)	No. of tillers/ plant	Plant height (cm)						Dry matter accumulation (t/ha)					
				1st cut (55 DAS)	2nd cut (85 DAS)	3rd cut (115 DAS)	4th cut (145 DAS)	5th cut (175 DAS)	Mean	1st cut (55 DAS)	2nd cut (85 DAS)	3rd cut (115 DAS)	4th cut (145 DAS)	5th cut (175 DAS)	Sum
Sowing dates															
5th November	390.1	9.49	6.61	24.8	37.5	63.8	71.4	69.1	51.7	1.82	2.30	2.41	2.83	1.60	11.1
15th November	377.1	10.3	6.74	22.2	35.8	62.4	69.4	41.3	47.4	1.51	2.01	2.29	2.58	1.21	9.41
25th November	364.7	12.0	6.80	20.8	34.7	61.5	51.3	-	43.9	1.36	1.95	2.35	1.84	-	7.42
5th December	349.8	13.1	6.89	18.4	32.3	64.8	47.2	-	40.8	1.28	1.90	2.71	0.78	-	6.54
15th December	338.2	15.8	6.98	16.2	31.0	70.5	26.7	-	36.3	1.20	2.11	2.86	-	-	5.35
C. D. (P=0.05)	23.3	0.56	NS	1.21	0.79	0.69	-	-	2.9	0.07	0.04	0.05	-	-	0.58
Date of last cut															
5th April	-	-	6.88	20.48	34.3	64.8	45.4	-	40.9	1.37	2.04	2.45	1.35	-	7.24
15th April	-	-	6.80	20.23	34.6	64.2	59.3	-	44.3	1.36	2.03	2.43	2.01	-	7.83
25th April	-	-	6.72	20.56	34.5	63.7	69.5	44.3	46.8	1.38	2.05	2.54	2.31	0.65	8.83
C. D. (P=0.05)	-	-	NS	NS	NS	NS	-	-	2.3	NS	NS	NS	-	-	0.36

(November 5) recorded the highest total dry matter accumulation (of 55, 85, 115, 145 and 175 DAS) of 11.1 t/ha, which was significantly higher than November 15 sown crop. Similarly, further delay in sowing also resulted in consistent decrease in dry matter accumulation. The total highest dry matter accumulation under early sown dates might be due to more number of cuttings. The results were in conformity with findings of Kumar (2017) who reported similar results in Lucerne.

The dry matter accumulation at 55, 85 and 115 DAS did not varied significantly at last cutting dates. However the total dry matter accumulation (of 55, 85, 115, 145 and 175 DAS) was found to be significantly affected. Data brings out that each delay in last cutting date resulted in significant increase in dry matter accumulation. The increase in dry matter due to 25th April cutting date over 5th and 15th April cutting date was 21.96% and 12.64%, respectively. The results were in conformity with the findings of Deore and Desai (1983). All interactions were found to be non significant.

Green fodder yield

The data presented in the Table 2 showed significant effect of date of sowing and date of last cut on green fodder yield. The green fodder yield at 55 and 85 DAS was observed to be significantly highest on 5 November date of sowing. At 115 DAS, the highest green fodder yield was observed in treatment D_5 (21.8 t/ha) and lowest at treatment D_2 (17.3 t/ha). Among different sowing times, sowing the crop on 5th November resulted in significantly higher total green fodder (79.3) than 15th November (70.70), 25th November (59.3), 5th December (54.5) and 15th December (47.8t/ha). Percent increase with 5th November was 12.2%, 33.7%, 45.5%, 65.9% over 15th November, 25th November, 5th December and 15th December respectively. The higher fodder yield under earlier sown crop might be due to increased life span of crop and availability of congenial climatic conditions for growth and development of crop. The results were in conformity with the findings of Sardana and Narwal (2000). The green fodder yield at 55, 85 and 115 DAS did not varied significantly at last cutting dates. But on other hand, among three dates of last cut, cutting the crop on 25th April resulted in significantly higher total green fodder yield (69.1) than 15th April and 5th April. Percent increase was 12.7% and 22.3% with 15th April and 5th April respectively. The increase in green fodder yield due to last cutting date on 25th April (C_3) may be attributed to the occurrence of an extra cut in this treatment. The results were in conformity with the findings of Sardana and Narwal (2000). All interactions were found to be non significant.

Biological yield

The data presented in the Table 2 indicated that biological yield varied significantly with date of sowings. Data indicated that delay in sowing from November 5 to December 15 caused consistent increase in biological yield, through the differences between consecutive dates were not significant. Each delay of 10 days from 5 November to 15 December resulted in 2.34%, 10.28%, 17.28% and 23.83%

TABLE 2
Effect of date of sowing and cutting management on yield and economics

Treatments	Green fodder yield (t/ha)						Biological yield (q/ha)	Harvest index (%)	B : C
	1st Cut (55 DAS)	2nd Cut	3rd Cut (85 DAS)	4th Cut (115 DAS)	5th Cut (145 DAS)	Mean (175 DAS)			
Sowing dates									
5th November	12.7	16.9	18.2	21.3	10.6	79.3	21.4	18.9	2.81
15th November	11.1	15.3	17.3	19.1	7.90	70.7	21.9	19.2	2.68
25th November	10.1	14.8	19.1	15.2	-	59.3	23.6	18.6	2.54
5th December	9.4	14.2	20.6	5.51	-	54.3	25.1	18.3	2.55
15th December	9.0	16.5	21.8	-	-	47.8	26.5	17.7	2.45
CD (p=0.05)	0.30	0.51	0.69	-	-	4.73	1.95	NS	-
Date of last cut									
5th April	10.5	15.5	19.4	10.3	-	56.5	26.5	19.1	2.84
15th April	10.2	15.2	19.3	16.5	-	61.3	23.2	18.4	2.52
25th April	10.5	15.6	19.6	18.3	5.1	69.1	21.4	18.1	2.45
C. D. (P=0.05)	NS	NS	NS	-	-	2.88	1.00	NS	-

increase in biological yield of berseem. The presented data was in conformity with the finding of Taneja *et al* (1987). The last cutting date treatments also affected the biological yield of berseem significantly. Amongst these treatments, C_1 had highest value of 26.1 followed by C_2 (23.4) and C_3 (21.8).The minimum value of C_3 can be attributed to the fact that the plant height (Table 4.3) and dry matter accumulation (Table 2) were less in this treatment. The presented data is in agreement with Sardana and Narwal (2000). All interactions were found to be non significant.

Harvest index

The data presented in the Table 2 revealed that harvest index did not varied significantly under the influence of date of sowings and last cut. However, leaving the crop at an early date resulted in increase in harvest index by about 1% over later date. All interactions were found to be non significant.

ECONOMICS

The economic analysis of different sowing dates and last cut treatments was done by considering the cost of cultivation per hectare, gross return per hectare and net return per hectare under different treatments. Amongst different dates of sowing the highest net returns were recorded under earlier sown crop (5 November). This was followed by treatment D_2, D_4, D_3 and D_5. Amongst different last cutting dates treatments the highest net returns were obtained by the C_1 (81392 Rs/ha) followed by C_2 and C_3. The highest benefit: cost ratio was obtained by the treatment D_1 (2.81). This was followed by treatment D_2 (2.68), D_4 (2.54), D_3 (2.55) and D_5 (2.45) Thus it is more economical to adopt the treatment 5th November (D_1) as compared to other dates of sowing to obtain maximum benefit from cultivation of dual purpose berseem. Amongst different last cutting dates treatments the highest benefit: cost ratio was obtained by the treatment C_1 (2.84). This was followed by treatment C_2 and C_3.

CONCLUSION

Based on the results, it may be concluded that depending upon the growing resourses, cropping system adopted and interests of farmers, the sowing and last cut dates of berseem can be manipulated. For instance, a grower interested in fodder purpose should sow the crop on an early date (D_1: November 5). Similarly, delay in last cut (25 April) could increase the fodder yield. Since this data is based on one year experiment, repetition of experiment along with multi-locational trials is needed.

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