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EFFECT OF BIOFERTILIZERS AND CUTTING MANAGEMENT ON YIELD AND YIELD ATTRIBUTES OF DIFFERENT CULTIVARS OF BERSEEM (*TRIFOLIUM ALEXANDRINUM* L.)

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SUMMARY

A field experiment was carried out to examine the response four types of cuttings (C_1= cutting 1.5 above ground, C_2= cutting 3.5 above ground, C_3= cutting 5.5 above ground and C_4= cutting 7.5 above ground) and three levels of biofertilizers viz. (B_0= Control, B_1= *Rhizobium* and B_2= *Rhizobium* + PSB) with two varieties of berseem viz. V_1= Mescavi (Pusa) and V_2= Bhart Kaveri on yield and yield attributes of berseem (*Trifolium alexandrinum L.*) and was laid in a factorial randomized block design with four replications. The results revealed that various types of cuttings significantly affected the yield and yield of berseem and maximum was recorded with treatment C_3 *i.e.* when cutting was at 5.5 above the ground. In case of different levels of biofertilizers, yield and yield attributes of berseem were observed to be highest with the combined application of *Rhizobium* + PSB (treatment B_3). Moreover, Moreover, it was evident from the results that the different varieties of berseem varied significantly in yield and yield attributes of berseem and var. Mescavi (Pusa) was found to be superior in every aspect and gave the higher green fodder yield of 151.25 q ha^{-1} over local variety (Bhart Kaveri) of berseem (144. q ha^{-1}).

Key words : Growth, yield, berseem, biofertlizers, varieties and cuttings

Berseem (*Trifolium alexandrinum L.*) called "Egyptian clover" is an annual, cool season forage crop grown in various parts of India along with other Asian countries. It is an annual leguminous crop, well adapted to the semi-arid conditions of the Northern India with good nitrogen fixing ability and gives several cuttings during its growing season. Berseem fodder is highly palatable due to its succulence and nutritious with 20% crude protein and 62% total digestible nutrients. Therefore, it is very suitable green fodder for all classes of livestock. Besides being a good green fodder, the importance of berseem in increased soil fertility is universally recognized and this beneficial effect is usually attributed the nitrogen added to the soil by the legume in a crop rotation. By keeping in view the importance of the berseem crop it is essential to raise the per hectare of the crop but nutrient availability is one the most important factors during plant development. While with the adoption of suitable varieties, proper seed inoculation of the berseem crop, adoption of improved agronomic practices and most importantly judicious use of biofertilzers and manures along with fertilizers is a critical component to crop production in sustainable farming systems (Canbolat *et al.,* 2006) and can raise the production per hectare of the berseem green fodder to a considerable extent. Temperature, humidity and radiation are major meteorological parameters, which influence all aspects and stages of crop growth and climatic variability, temperature is a key component of climate, determining the rate and duration of growth and productivity of crop (Pal *et al*., 2001). So, in this regard, adoption of improved berseem varieties is one of the most important methods of increasing green fodder yield of berseem per hectare. Generally the berseem crop grown in India is diploid. Lack of systematic and scientific manuring is the most important factor affecting the yield per hectare of green fodder of berseem. Hence, the present investigation was undertaken with the objective to the study the growth and yield parameters of berseem as influenced by biofertilizers and cutting management in different varieties of berseem under irrigated conditions.

MATERIALS AND METHODS

The present investigation was conducted at the Agricultural Research Farm of J.V. College, Baraut (Baghpat), Uttar Pradesh. The experiment was laid out in a factorial randomized block design with four types

of cuttings (C_1= cutting 1.5 above ground, C_2= cutting 3.5 above ground, C_3= cutting 5.5 above ground and C_4= cutting 7.5 above ground), three levels of biofertilizers viz. (B_0= Control, B_1= *Rhizobium* and B_2= *Rhizobium* + PSB) and two varieties of berseem viz. V_1= Mescavi (Pusa) and V_2= Bharrt KAVERI (20 cal) with four replications. Before sowing of Berseem, soil samples from 0-15 cm depth were taken from the experimental field and analyzed for physical and chemical properties to find out the fertility status and soil class (Table 1). The preparation of the experimental field was done by following local package and practices. After preparing the field, it was divided into 4 replications with 24-plots is each replication. The plant height (cm), the number of leaves and number of branches per plant of 5 randomly selected plants of berseem in the net plot area were measured from ground level up to the base of last leaf of berseem at 40 and the average values were subjected to statistical analysis. Moreover, the randomly uprooted plants of berseem were also subjected to count the number of nodules per plant after every cutting the average value subjected to statistical analysis. Finally, green fodder yield (q/ha) was made by every cutting for every net plot and weighed and converted into q/ha. The statistical analysis of each biometrical observation was done by the method suggested by Fisher and Yates (1957) for the factorial RBD. The significance of treatment effects was tested with the help of "F" test and the significance of difference between two means to treatments were tested by critical difference (CD).

TABLE 1
Physico-chemical properties of the experimental soil

Soil components	Values (%)	Method of Analysis
A. Mechanical analysis		
(i) Sand (%)	51.6	Hydrometer method
(ii) Silt (%)	22.4	
(iii) Clay (%)	26.0	
***The soil of the experimental field is sandy clay loam**		
B. Chemical analysis		
(i) Organic carbon (%)	0.56	Walkley and Black, 1934
(ii) Available N (kg/ha)	235.76	Subbiah and Asija, 1956
(iii) Available P (kg/ha)	16.58	Olsen et al., 1954
(iv) Available K (kg/ha)	246.40	Flame photometer
(v) pH	7.60	Jackson, 1967
(vi) EC (dS/m)	2.11	Richards, 1954

RESULTS

Yield attributes : The data regarding yield attributes (plant height (cm), number of leaves per plant, number of branches per plant and number of inter node per plant) is tabulated and presented in table 2. The Data indicated that the various cutting of berseem for green fodder significantly influenced the yield attributes and the C_3 cutting *i.e.*, cutting 5.5 cm above the ground obtained significantly higher plant height (29.51 cm), number of leaves per plant (26.22), number of branches per plant (7.88) and number of

TABLE 2
Effect of cuttings, bio-fertilizers and varieties of berseem on plant height, number of leaves/plant, number of branches/plant and number of inter node/plant

Treatments	Plant height (cm)	No. of leaves/ plant	No. of branches/ plant	No. of inter node/ plant
A. Cuttings				
C_1	16.76	14.89	4.43	4.83
C_2	28.28	25.13	7.55	8.15
C_3	29.51	26.22	7.88	5.50
C_4	26.86	23.86	7.17	7.73
S. Ed	0.59	0.44	0.14	0.15
C. D. (P=0.05)	1.17	0.86	0.27	0.29
B. Bio-fertilizers				
B_0	22.31	19.82	5.96	6.43
B_1	25.63	22.77	6.81	7.38
B_2	28.12	24.99	7.50	8.10
S. Ed	0.51	0.38	0.12	0.13
C. D. (P=0.05)	1.01	0.74	0.23	0.25
C. Varieties				
V_1	26.93	23.93	7.17	7.76
V_2	23.77	21.12	6.34	6.85
S. Ed	0.42	0.31	0.10	0.10
C. D. (P=0.05)	0.83	0.61	0.19	0.20

inter node per plant (8.15) followed by C_2 (28.28 cm, 25.13, 7.55, 7.73) cutting over C_4 (26.86 cm, 23.86, 7.17, 5.50). Whereas, C_1 cutting of berseem was observed to have significantly lower plant height (16.76 cm), number of leaves per plant (14.89), number of branches per plant (4.13) and number of inter node per plant (4.83), respectively. Moreover, the various bio-fertilizers also significantly affected the yield attributes of berseem and plant height (28.12 cm), number of leaves per plant (24.99), number of branches per plant (7.50) and number of inter node per plant (8.10) were observed to be the highest with the application of *Rhizobium* + PSB over alone *Rhizobium* application (25.63 cm, 22.77, 6.81, 7.38) and control plot (22.31 cm, 19.82, 5.96, 6.43), respectively. The lowest plant height of berseem was found in control plot (without *Rhizobium* and PSB). Moreover, among the different varieties of berseem, var. Mescavi gave the tallest plants of height 26.93 cm and found to have significantly higher number of leaves per plant (23.93), number of branches per plant (7.17) and number of inter node per plant (7.76) over local varieties (23.77 cm, 21.12, 6.34, 6.85), respectively. The main effects cuttings, biofertilizers and different varieties on yield attributes of berseem are also lustrated by graph (Fig. 1).

Fresh and Dry weight (g) per plant : The data regarding fresh and dry weight (g) per plant after

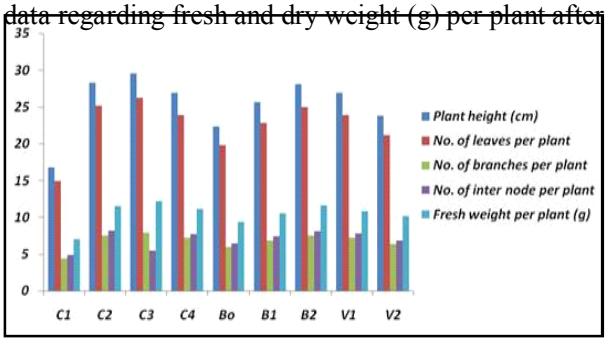

Fig. 1. Effects of cuttings, bio-fertilizers and varieties on yield attributes of Berseem.

every cutting of berseem was analysed statistically and tabulated in Table 3. The results revealed that the different types of cutting significantly affected the fresh and dry weight (g) per plant and the C_3 cutting of berseem was observed to have the highest fresh and dry weight (g) per plant *i.e.*, 12.20 g and 1.86 g, respectively followed by C_2 (11.53 and 1.79 g) and C_4 (11.15 and 1.69 g) cuttings and C_1 (7.01 and 1.06 g) cuttings, respectively. Further, it was revealed that the different bio-fertilizers combinations also significantly affected the fresh and dry weight (g) per

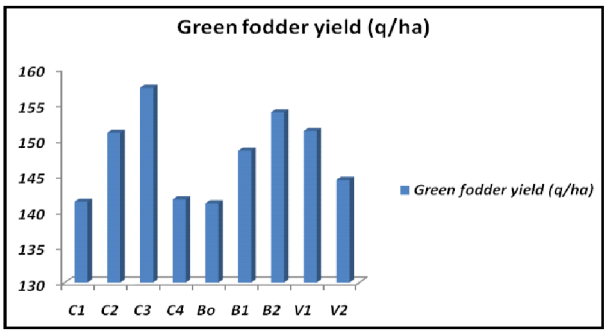

Fig. 2. Effects of cuttings, bio-fertilizers and varieties on green fodder yield (q/ha) of Berseem.

plant of berseem. With the combined application of *Rhizobium* + PSB bio-fertilizers, the highest fresh and dry weight (g) per plant (11.56 and 1.77 g) was obtained over alone use of *Rhizobium* (10.52 and 1.62 g) and untreated plot (9.34 and 1.41 g), respectively. Moreover, it was evident from the results that the different varieties of berseem varied significantly in fresh and dry weight (g) per plant and the var. Mescavi found to have significantly higher fresh and dry weight (g) per plant (10.83 and 1.70 g) over local variety of berseem (10.12 and 1.50 g).

Green fodder yield (q/ha) : It is clear from the results presented in table 3, that the various types of cuttings significantly influenced the green fodder yield and the C_3 cutting was observed to have significantly higher green fodder yield (157.33 q/ha) followed by C_2 (151.00 q/ha) and C_4 (141.67 q/ha) cuttings while least was observed in C_1 cutting (141.33 q/ha). Further, it was revealed that the different bio-fertilizers combinations also significantly affected the green fodder yield of berseem. With the combined application of *Rhizobium* + PSB bio-fertilizers, highest green fodder yield (153.88 q/ha) was obtained over alone use of *Rhizobium* (148.50 q/ha) and untreated plot (141.12 q/ha), respectively. Moreover, it was evident from the results that the different varieties of berseem varied significantly in green fodder yield and the Pusa genotypes found significantly higher green fodder yield (151.25 q/ha) over local variety of berseem (144.42 q/ha). The main effects of cuttings, various bio-fertilizers and different varieties have been also depicted graphically in Fig. 2.

DISCUSSION

Effect of cuttings : The various types of cuttings significantly affected the plant height and with C_3 cutting the plant height, number of leaves per plant,

number of branches per plant, number of inter node per plant (table 2), fresh and dry weight per plant and green fodder yield q/ha (table 3) were observed to be significantly higher over types of cuttings i.e. C_1, C_2 and C_4. The higher green fodder yield and yield attributes in third cutting (C_3) might be possibly due to because of the fact that even though phenology is one of the genetically controlled character specific to the cultivar, it is highly influenced by the management practices as well as climatic conditions. Since plant requires certain vegetative growth before initiation of reproductive phase, delay in cutting will result in increase in number of days to flower and thereby decreasing the green folder yield with delay in cutting. Similar results were found by other workers in diploid berseem, where the total time for reproductive phase was substantially increased with delay in last cut (Sardana and Narwal, 2000). Similar findings were also reported some other researchers also (Kumar and Verma, 2003; Lannucci *et. al.,* 2006 and Lannucci, 2004).

Effect of bio-fertilizers : The yield and yield attributes were significantly increased with the application of *Rhizobium* + PSB. It is attributed due to the *Rhizobium* + PSB the availability of plant nutrients as like nitrogen, phosphorus potash so that the plant height, number of leaves per plant, number of branches per plant, number of inter node per plant, fresh weight per plant and dry weight per plant. It is attributed due to *Rhizobium* + PSB increased the availability of berseem plant and increased the nitrogen fixation due to increase the number of nodules on root. Similar findings are also reported by Meena and Mann (2006) who reported that application of 20 kg N + 60 kg P + mixture of *Rhizobium trifolii* and phosphate solubilizing bacteria (PSB) recorded highest green fodder (65.45 t/ha), dry matter yield (16.98 t/ha) and protein content (19.7%) of berseem. Basanthi *et al.* (2012b) also reported that application of farm yard manure+*Rhizobium*+phosphate solubilizing bacteria + *Azospirillium* resulted in maximum plant height (13.1 cm at 35 DAS), fresh forage yield (16780 kg/ha), maximum length of head (2.7 cm), maximum number of flowers per head (83 flowers/head) and maximum seed yield (387.2 kg/ha). The similar findings were also reported by Patel *et al.,* 2010 and Sonali *et al.,* 2012.

Effect of varieties : The effect of different cultivar significantly affected the yield and yield attributes of berseem and with Mescavi Pusa genotypes the plant height, number of leaves per plant, number of branches per plant, number of inter node per plant, fresh and dry weight per plant and green fodder yield q/ha were observed to be significantly higher over local variety of berseem. This may be attributed to the reason that Pusa variety may be well adapted to that environment of evaluation and due to its better genotype have found to be the best performer among

TABLE 3
Effect of cuttings, bio-fertilizers and varieties of berseem on fresh weight, dry weight and green fodder yield

Treatments	Fresh weight/plant (g)	Dry weight/plant (g)	Green fodder yield (q/ha)
A. Cuttings			
C_1	7.01	1.058	141.33
C_2	11.53	1.785	151.00
C_3	12.20	1.863	157.33
C_4	11.15	1.693	141.67
S. Ed	0.28	0.032	2.01
C. D. (P=0.05)	0.56	0.063	3.98
B. Bio-fertilizers			
B_0	9.34	1.407	141.12
B_1	10.52	1.618	148.50
B_2	11.56	1.775	153.88
S. Ed	0.25	0.027	1.74
C. D. (P=0.05)	0.49	0.054	3.44
C. Varieties			
V_1	10.83	1.700	151.25
V_2	10.12	1.500	144.42
S. Ed	0.20	0.022	1.42
C. D. (P=0.05)	0.40	0.044	2.51

the tested varieties. These results are in agreement with those reported by Lannucci (2004) and Santis *et al.* (2004).

CONCLUSION

It seems that improving the nutrition through combination of different biofertilizers along with recommended dose of fertilizers causes the appropriate nutritional conditions and increases the nutrients uptake and leads to improvement in growth of berssem. Based on the study results it can be concluded cutting 5.5 cm above the ground in conjugation with *Rhizobium* + PSB with Pusa variety recorded the higher growth and green fodder yield and yield parameters of berseem under irrigated conditions.

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