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PERFORMANCE OF BERSEEM (*TRIFOLIUM ALEXANDRINUM* L.) GENOTYPES AT DIFFERENT PHOSPHORUS LEVELS

UMA DEVI[1] AND SATPAL[2]*

[1] Department of Agronomy & [2] Forage Section, Department of Genetics & Plant Breeding
CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
* *(e-mail : satpal.fpj@gmail.com*)

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SUMMARY

A field experiment was conducted at Forage Section Research Farm, Dept. of Genetics and Plant breeding, CCS Haryana Agricultural University, Hisar (Haryana) during winter season (*Rabi*) of 2017-18 to study the response of different phosphorus levels on the yield and quality of berseem (*Trifolium alexandrinum* L.) genotypes. The experiment was laid out in split plot design with five promising berseem genotypes (JB-05-9, PC-82, Wardan, Mescavi and Bundel Berseem-2) in main plot and three phosphorus levels in sub plot (60, 80 and 100 kg P_2O_5/ha) and replicated thrice. Maximum number of tillers/ft^2 was recorded in Wardan which was at par with all entries except Bundel Berseem-2. Highest total green fodder and dry matter yield (687 and 93 q/ha, respectively) were recorded in variety JB-05-9 which was at par with all berseem varieties except Bundel Berseem-2. Maximum B: C ratio (1.37) was also observed in JB-05-9 followed by Wardan. Among different levels of phosphorus, highest green fodder yield, dry matter yield, average number of tillers/ft^2 and plant height were recorded with the application of 100 kg P_2O_5/ha which were found at par with 80 kg P_2O_5/ha but significantly superior to 60 kg P_2O_5/ha. Highest crude protein content (21.96%) was also estimated with 100 kg P_2O_5/ha which was significantly superior over the lower levels of phosphorus (60 and 80 kg P_2O_5/ha). Similar trend was also observed in crude protein yield. B: C ratio was found to be highest (1.38) with 100 kg P_2O_5/ha followed by 80 kg P_2O_5/ha.

Key words : Berseem, green fodder yield, dry matter, phosphorus level, crude protein content

Berseem (*Trifolium alexandrinum* L.) is one of the most important leguminous fodders of subtropical countries. It was introduced in India from Egypt in 1904; started cultivation as a rotational crops at government cattle farm, since 1910 its cultivation was taken up by cultivators (Das Gupta, 1943). In northern India, this crop is grown in *rabi* season as multi-cut fodder annual and has a maturity period of about six months. Berseem forms a major part of the animal diet from November to April in the central and northern-western parts of India. It is highly nutritious forage contains 15.8-26.7% crude protein, 14.9-28.3% crude fiber, 1.4-3.0% ether extract, 1.40-2.58% calcium and 2.52-4.25% nitrogen content and about 0.14-0.20% phosphorus content. Berseem is now a much popular and established fodder crop due to its multi-cut nature (4-8 cuts), providing fodder for a long duration (November to May), very high quantum of green fodder and better quality of fodder, high and palatability (Singh *et al*., 2019). Owing to its high demand in milk shed areas and it has wider adaptability, high regeneration capacity, quick growth, high out turn of green fodder, high palatability, easy digestibility and easy cultivation practices, the economic return of this crop are more than other fodder crops. The varietals improvement in this crop however, could get a slow momentum (Shukla and Patil, 1985). Phosphorus is an essential plant nutrient as it stands next to nitrogen which is required for the root growth and also helps in absorption of different plant nutrients. Berseem, being a leguminous crop, requires sufficient quantity of phosphorus in free form for better nodulation. Also, phosphorus plays a fundamental role in number of enzymatic reactions and protein synthesis. It plays a major role in energy transfer system (ADP, ATP). Thus, phosphorus is essential for a numerous metabolic processes. Through the sufficient research work has been conducted on phosphate fertilization of berseem in different part of country, which has proved that application of phosphate has produced tremendous effect on the yield of berseem and its quality. Also, several workers (Rana *et al.*, 1992; Mani and Singh, 1997 and Godara *et al.*, 2016) reported that increasing phosphorus fertilization

levels caused linear increases in fresh and dry forage yield, Plant height and number of shoots/plant of Berseem. However, the present study on performance of five genotypes of berseem under three phosphorus levels was carried out at CCS HAU, Hisar.

MATERIALS AND METHODS

The study was conducted at Forage Section Research Farm area of CCS Haryana Agricultural University, Hisar, India (29° 10' N of 75° 46' E, at an average elevation of 215.2 m above mean sea level). The soil of the experimental site was sandy loam having pH 7.7, EC 0.26 dS/m, organic carbon 0.50 per cent and available P and K were 13 and 194 kg/ha, respectively. The weekly weather parameters during the crop season are given in Fig. 1. The treatment were five multi-cut entries of berseem *viz.*, JB-05-9, PC-82, Wardan, Mescavi and Bundel Berseem-2 and three phosphorus levels (60, 80 and 100 kg/ha). The experiment was laid out in split plot design allocating berseem varieties (JB-05-9, PC-82, Wardan, Mescavi and Bundel Berseem-2) in main plot and phosphorus levels (60, 80 and 100 kg P_2O_5/ha) in sub plot and replicated thrice. In the experiment, two test genotypes JB-05-9 and PC-82 were compared with Wardan and Mescavi (North-Central Zonal Checks) and Bundel Berseem-2 (Zonal check- North-West Zone). The gross plot size was 4m × 3m. The calculated quantity of P fertilizer doses as per treatments and 20 kg/ha N as basal dose were applied in the respective plots according to the design and mixed with the soil at the time of sowing and seed was sown by broadcasting with irrigation. The sowing was done on 11 November 2017. Next irrigations were applied as and when requirement of irrigation rises after seedling establishment. Plant population was recorded by counting the tillers number per square meter putting quadrate from three random spots in all 45 plots at each cut. Plant height was also taken of three randomly selected plants at every harvesting time. For green fodder, crop was harvested first at 60 days after sowing (DAS) and thereafter 30-40 days interval. Total five cuts were taken. The crop was harvested from each net plot area individually and weighed. Thus green fodder yield was recorded and converted in q/ha. Dry matter yield (q/ha) was taken from fresh 500 g sample of green fodder after complete drying. Plant samples were also analyzed in lab for quality analysis. The crude protein content was calculated by multiplying the nitrogen percentage with 6.25 estimated by conventional micro-Kjeldhal method (AOAC, 1995). Economics was worked out on the basis of prevailing market prices of inputs and outputs in the local market. The experimental data were analyzed by using OPSTAT software available on CCS Haryana Agricultural University website (Sheoran *et. al.*, 1998). The results are presented at five per cent level of significance (P=0.05) for making comparison between treatments.

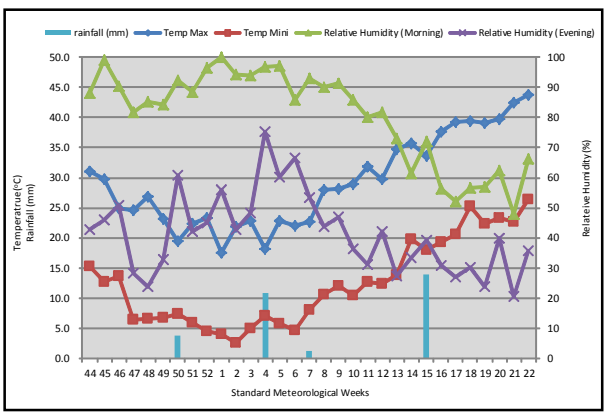

Fig. 1. Weekly weather parameters during the crop season.

RESULTS AND DISCUSSION

Effect of Genotypes

Data presented in Table 1 reveal that among different varieties, maximum average number of tillers/foot^2 (47.89) was recorded in Wardan, which was at par with all the entries *viz.*, JB-05-9, Mescavi and PC-82 except Bundel Berseem-2. However, the lowest number of tillers/foot^2 (43.61) was recorded with the genotype Bundel Berseem-2. Plant height was not affected significantly among different varieties, however, the maximum plant height (57.96 cm) and lowest plant height (53.25 cm) was recorded with JB-05-9 and Bundel Berseem-2 genotypes respectively. The differences in growth characters due to varieties may be attributed to their inherent characteristics. The green fodder yield as well as dry matter yield (687.08 and 93.28 q/ha, respectively) was recorded highest with the genotype JB-05-9, which was at par with all other genotypes like Mescavi and PC-82 except Bundel Berseem- 2. This may be described that the differences in growth and yield attributing parameters of varieties are due to genetic characters of each variety and the variety JB-05-9 recorded significantly higher growth attributes character as compared to other varieties. The cut-wise performance of green fodder and dry matter yield of the berseem genotypes is given in Fig. 2 & 3, respectively. The crude protein content

was not affected significantly among genotypes. The maximum crude protein yield (19.98 q/ha) was recorded with JB-05-9 which was on a par with all the genotypes except Bundel Berseem-2. Economic data presented in Table 2 reveal that amongst genotypes, the maximum gross returns (Rs. 85885/ha), net return (Rs. 23,160/ha) and B:C (1.37) were fetched with JB-05-9. Godara *et. al.* (2016) also reported genotypic variations among genotypes for fodder yields and quality.

Effect of Phosphorus

All the growth parameters, green fodder as well as dry matter yield and average crude protein content and yield increased with increasing levels of phosphorus. Highest green fodder yield, dry matter yield, average number of tillers per square foot and plant height were recorded with application of 100 kg P_2O_5/ha which was at par with 80 kg P_2O_5/ha but significantly superior to 60 kg P_2O_5/ha. It may be due to the good emergence and more number of branches which resulted to higher fresh forage yield (Saeed *et. al*., 2011). The cut-wise performance of green fodder and dry matter yield of the berseem genotypes at different phosphorus levels is given in Fig. 4 & 5, respectively. Data on economics presented in table 2 reveal that among different levels of phosphorus, application of 100 kg P_2O_5/ha gave maximum gross returns (Rs.88148/ha), net returns (Rs.24400/ha) and B:C ratio (1.38) closely followed by 80 kg/ha. The result confirms the findings of Godara *et. al* (2016). The increase in growth characters, forage and crude protein yields in this investigation might be attributed to increased cell expansion and various metabolic processes because of greater nutrient uptake in the presence of abundant available phosphorus. Highest crude protein content (21.96%) was estimated with the application of 100 kg P_2O_5/ha which was significantly superior over the lower levels of phosphorus. Similar trend was also observed in crude protein yield.

CONCLUSION

Based on the results, it was concluded that for getting higher quantity of green and dry fodder, berseem crop should not be fertilized with less than 80 kg P_2O_5/ha. Although, the quality of berseem fodder in terms of crude protein content and crude protein yield increased significantly up to 100 kg P_2O_5/ha. For ensuring maximum fodder yield, quality and economics, berseem crop can be fertilized with 100 kg P_2O_5/ha. Among genotypes, the berseem test entry JB-05-9 performed better over others but it was on a par with other test entry PC-82 and two other checks (Wardan and Mescavi) in terms of fodder yield and quality.

TABLE 1
Effect of P levels on performance of berseem genotypes during Rabi 2017-18

Treatments	Average no. of tillers/foot^2	Average plant height (cm)	Total green fodder yield (q/ha)	Total dry matter yield (q/ha)	Average crude protein content (%)	Total crude protein yield (q/ha)
Genotypes						
JB-05-9	47.38	57.96	687.08	93.28	21.47	19.98
PC-82	46.67	56.40	667.88	91.44	21.45	19.43
Wardan	47.89	55.18	684.03	91.00	21.55	19.62
Mescavi	47.16	57.04	674.91	91.62	21.52	19.59
Bundel Berseem-2	43.61	53.25	647.73	84.79	21.35	18.07
S. Em±	0.85	1.00	7.67	1.17	0.11	0.28
C. D. (P=0.05)	2.81	NS	25.40	3.86	NS	0.92
P Levels						
60 kg P_2O_5/ha	43.72	53.42	624.87	82.25	21.02	17.18
80 kg P_2O_5/ha	47.26	56.66	686.91	93.22	21.43	19.89
100 kg P_2O_5/ha	48.65	57.81	705.20	95.81	21.96	20.95
S. Em±	0.50	0.41	6.57	1.03	0.08	0.24
C. D. (P=0.05)	1.49	1.22	19.53	3.06	0.22	0.70
C. V. (%)	4.18	2.84	3.79	4.41	1.36	4.71

TABLE 2
Effect of phosphorus levels on economics of promising genotypes of berseem

Treatments	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B : C ratio
Genotypes				
JB-05-9	62725	85885	23160	1.37
PC-82	62725	83484	20759	1.33
Wardan	62725	85502	22777	1.36
Mescavi	62725	84363	21638	1.34
Bundel Berseem-2	62725	80964	18239	1.29
P Levels				
60 kg P_2O_5/ha	61703	78107	16404	1.27
80 kg P_2O_5/ha	62725	85865	23140	1.37
100 kg P_2O_5/ha	63748	88148	24400	1.38

B : C-Benefit : Cost.

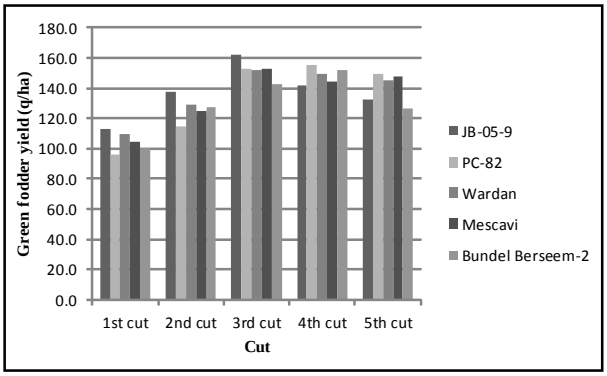

Fig. 2. Cut-wise green fodder yield of berseem genotypes.

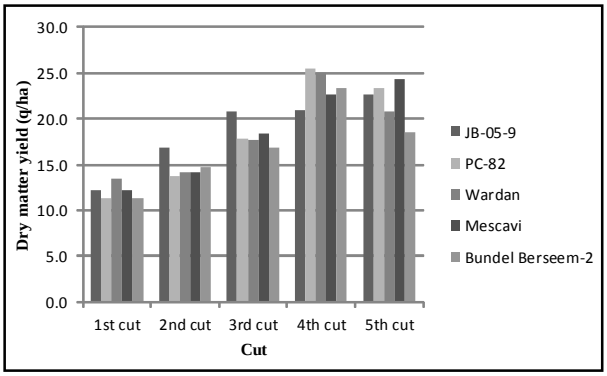

Fig. 3. Cut-wise dry matter yield of berseem genotypes.

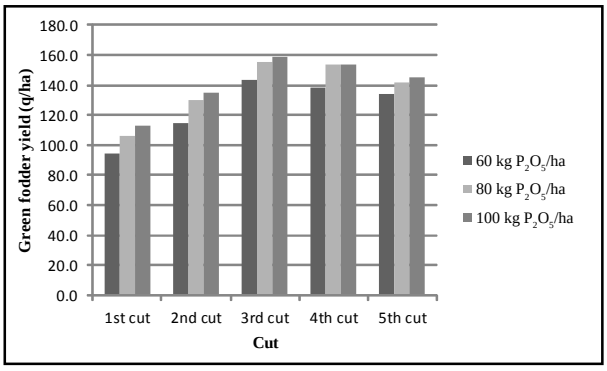

Fig. 4. Cut-wise green fodder yield at different P levels.

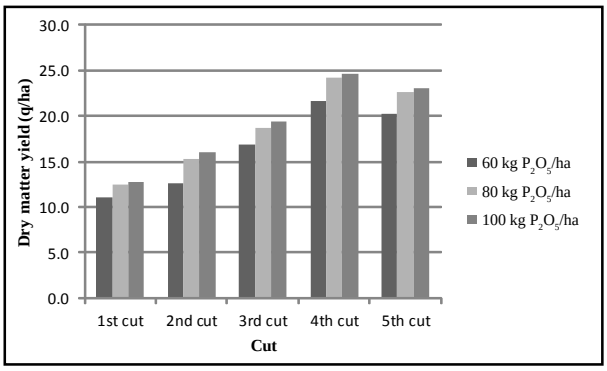

Fig. 5. Cut-wise dry matter yield at different P levels.

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