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# RESPONSE OF BERSEEM (*TRIFOLIUM ALEXANDRINUM* L.) GENOTYPES TO DIFFERENT PHOSPHORUS LEVELS

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## SUMMARY

A field experiment was conducted at CCS Haryana Agricultural University, Hisar (Haryana) during winter season (**rabi**) of 2014-15 to study the response of different phosphorus levels on the yield and quality of berseem (*Trifolium alexandrinum* L.) genotypes. Seven berseem genotypes viz., JBSC 1, JBSC 2, JBSC 3, JBSC 4, Bundel berseem 2, Wardan and Mescavi were sown with 60, 80 and 100 kg $P_2O_5$/ha. Among genotypes, JBSC 4 recorded highest number of shoots/m$^2$ (656.78), green fodder (425.89 q/ha) and dry matter yield (38.54 q/ha). JBSC 4 was also found superior in terms of crude protein content (18.75%) and crude protein yield (7.23 q/ha). Among different phosphorus levels, highest green fodder (380.86 q/ha) and dry matter yield (34.26 q/ha) were recorded with the application of 100 kg $P_2O_5$/ha which were on a par with 80 kg $P_2O_5$/ha but significantly superior over 60 kg $P_2O_5$/ha. Maximum crude protein content (18.38%) was estimated with the application of 80 kg $P_2O_5$/ha. However, its yield revealed increasing trend with increased levels of phosphorus, maximum with 100 kg $P_2O_5$/ha. Among genotypes, the maximum gross returns (Rs. 53,236/ha), net returns (Rs. 28,376/ha) and B : C ratio (1.14) were fetched with JBSC 4 closely followed by JBSC 2. Among different phosphorus levels, the maximum gross returns (Rs. 47,608/ha), net return (Rs. 21,786/ha) and B : C ratio (0.84) were fetched with the application of 100 kg $P_2O_5$/ha closely followed by 80 kg $P_2O_5$/ha.

**Key words :** Dry matter, green fodder yield, phosphorus, berseem, crude protein

The availability of nutritious fodder is inadequate in India. The low productivity and poor performance of the livestock are mainly due to unavailability of nutritious fodder in sufficient quantity. India faces a net deficit of 61.1 per cent green fodder, 21.9 per cent dry crop residues and 64 per cent feed & concentrates (Kumar *et al*., 2012). The most important constraint in the fodder production and productivity is the non-availability of improved variety seed of forage crops to the farmers. The supply of nutritious fodder is pre-requisite for the success of dairy sector (Kumar *et al*., 2010). Berseem or Egyptian clover (*Trifolium alexandrinum* L.), a potential winter forage legume, is one of the most popular crops in north, north-west and central parts of India. It is well known green forage crop that stimulate milk production in dairy animals. Berseem is in fact known as milk multiplier. Being a leguminous crop, it fixes atmospheric nitrogen and thus is also good for soil fertility (Williams *et al*., 1990). For higher green fodder yield, vegetative growth of the crop is very important. Although the vegetative growth of any crop largely depends upon the potential of the genotype, nutrient supply system, capacity of the soil to supply the nutrients to the crop and capacity of the plants to take and use the nutrients in unit time.

Among all the primary nutrients, phosphorus is one of the key mineral nutrients for rumen microbes and the host ruminant animal. The vast majority of phosphorus in concentrates is in the form of phytate. For stomach, phytate degradation is crucial for phosphorus utilization in ruminants. Phosphorus constitutes about 22 per cent of the mineral ash in an animal's body, a little less than one percent of total body weight. It is essential in transfer and utilization of energy. Earliest symptoms of P deficiency are decreased appetite, lowered blood P, reduced rate of gain, and "pica", in which the animals have a craving for unusual foods such as wood or other materials. If severe deficiency occurs, there will be skeletal problems. Milk production decreases with P deficiency, and efficiency of feed utilization is depressed. Long term P deficiency results in bone changes, lameness and stiff joints (Anonymous 1999).

Almost all the soils of Haryana are deficient in phosphorus and if the required amount of phosphorus of any crop is not supplied in sufficient amount then the deficiency of phosphorus is reflected in the straw and grain. Since phosphorus is an essential constituent of nucleic acids, nucleoproteins, amino acids, proteins, phosphotides, phytin, several co-enzymes and deficiency of phosphorus in fodder of the legume crops may cause severe disorders in animals and human beings. Therefore, it is essential to find out the optimum dose of phosphorus for increasing yield of berseem. Hence, the present investigation was undertaken to study the performance of different promising genotypes of berseem with different phosphorus levels.

## MATERIALS AND METHODS

A field experiment was conducted during **rabi** season of 2014-15 at Forage Section Research Farm of CCS Haryana Agricultural University, Hisar, Haryana, India (29° 10' N of 75° 46' E, at an average elevation of 215.2 m above mean sea level). The site has semi-arid and sub-tropical climate with hot dry summers and severe cold winters. Average annual rainfall is about 450 mm, 75 per cent of which is received in three months, from July to September during south-west monsoon. July and August are the wettest months. The crop received 94.5 mm rainfall during crop season. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 7.8), low in available nitrogen (184.5 kg/ha), medium in available phosphorus (14.0 kg/ha) and potassium (204.7 kg/ha). The experiment consisted of 21 treatment combinations comprising seven berseem genotypes (JBSC 1, JBSC 2, JBSC 3, JBSC 4, Bundel berseem 2 (BB 2), Wardan and Mescavi) and three phosphorus levels, viz. 60, 80 and 100 kg $P_2O_5$/ha. These treatments were tested in factorial randomized block design with three replications. The berseem genotypes as per treatment were sown manually on 6th December 2014 using the seed rate of 25 kg/ha. All the other standard agronomic practices for the cultivation of berseem were followed uniformly in all the treatments. All the genotypes were harvested at 90 days after sowing. Only one cut was taken in all the genotypes under all the treatments. The harvested green fodder from each plot was weighed *in situ* in kg/plot and then converted into q/ha. A random sample of 500 g was taken from each plot at the time of green fodder at harvest, chopped well and put into paper bag. These bags were aerated by making small holes all over. The samples were first dried in the sun for 15 days and then transferred in an electric hot air oven for drying at a temperature of 60±5°C till constant weight was achieved. On the basis of these samples, the green fodder yield was converted into dry matter yield (q/ha). Crude protein content (%) was estimated in dried and grinded samples (2 mm sieve size), collected at harvesting time. The crude protein content was calculated by multiplying the nitrogen percentage with 6.25 by conventional micro-Kjeldhal method (AOAC, 1995). Crude protein yield was calculated by the multiplication of crude protein content with dry matter yield (q/ha). 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 home page (Sheoran, 2016). The results are presented at 5 per cent level of significance (P=0.05) for making comparison between treatments.

## RESULTS AND DISCUSSION

### Effect of Genotypes

Data presented in Table 1 reveal that the maximum number of shoots/$m^2$ (656.78) was recorded with JBSC 4, which was significantly superior over BB 2, Wardan and Mescavi than rest of the genotypes. However, the lowest number of shoots/$m^2$ (228.44) was recorded with the genotype Wardan. The maximum plant height (84.89 cm) was recorded with JBSC 2 genotype which was at par with JBSC 4 but significantly superior over rest of the genotypes. However, lowest plant height (52.67 cm) was recorded with the genotype Wardan. The highest leaf : stem (L : S) ratio (0.68) was recorded in Wardan which was significantly superior over all the other genotypes. The green fodder yield was highest with the genotype JBSC 4 (425.89 q/ha), which was on a par with other genotypes like JBSC 1, JBSC 2 and JBSC 3 and superior over rest of the genotypes. The highest dry matter yield was recorded with JBSC 4 (38.54 q/ha), which was on a par with JBSC 1, JBSC 2 and JBSC 3 and significantly superior over rest of the genotypes. The maximum crude protein (18.75%) was observed with genotype JBSC 4 followed by JBSC 2, JBSC 1 and JBSC 3, respectively. The maximum crude protein yield (7.23 q/ha) was recorded with JBSC 4 followed by JBSC 2,

TABLE 1
Yields attributes, yield and quality of berseem genotypes as influenced by different levels of phosphorus during **rabi** season of 2014-15

| Treatment | Shoots/m$^2$ | Plant height (cm) | Leaf : stem ratio | Green fodder yield (q/ha) | Dry matter yield (q/ha) | Crude protein (%) | Crude protein yield (q/ha) |
|---|---|---|---|---|---|---|---|
| **A. Entries** | | | | | | | |
| JBSC-1 | 614.78 | 75.56 | 0.56 | 398.00 | 35.74 | 18.30 | 6.54 |
| JBSC-2 | 630.89 | 84.89 | 0.58 | 420.33 | 38.11 | 18.37 | 7.00 |
| JBSC-3 | 600.00 | 77.78 | 0.57 | 402.56 | 36.38 | 18.05 | 6.57 |
| JBSC-4 | 656.78 | 82.10 | 0.58 | 425.89 | 38.54 | 18.75 | 7.23 |
| Bundel Berseem 2 | 579.00 | 73.44 | 0.54 | 327.90 | 29.70 | 17.58 | 5.22 |
| Wardan | 228.44 | 52.67 | 0.68 | 177.78 | 15.94 | 17.97 | 2.86 |
| Mescavi | 566.67 | 70.11 | 0.54 | 282.30 | 25.61 | 17.60 | 4.51 |
| C. D. (P=0.05) | 66.44 | 5.27 | 0.03 | 34.87 | 2.92 | - | - |
| **B. $P_2O_5$ levels (kg/ha)** | | | | | | | |
| 60 | 497.89 | 68.00 | 0.54 | 302.33 | 27.44 | 17.79 | 4.88 |
| 80 | 569.33 | 75.38 | 0.59 | 360.29 | 32.50 | 18.38 | 5.97 |
| 100 | 594.22 | 78.00 | 0.61 | 380.86 | 34.26 | 18.11 | 6.20 |
| C. D. (P=0.05) | 43.44 | 3.45 | 0.02 | 22.83 | 1.91 | - | - |
| A × B | NS | NS | NS | NS | NS | - | - |

NS–Not Significant.

TABLE 2
Economic returns of different genotypes of berseem as influenced by different levels of phosphorus during **rabi** season of 2014-15

| Treatment | Gross returns (Rs./ha) | Cost of cultivation (Rs./ha) | Net returns (Rs./ha) | B : C ratio |
|---|---|---|---|---|
| **A. Genotypes** | | | | |
| JBSC-1 | 49750 | 24860 | 24890 | 1.00 |
| JBSC-2 | 52541 | 24860 | 27681 | 1.11 |
| JBSC-3 | 50320 | 24860 | 25460 | 1.02 |
| JBSC-4 | 53236 | 24860 | 28376 | 1.14 |
| Bundel Berseem 2 | 40988 | 24860 | 16128 | 0.65 |
| Wardan | 22223 | 24860 | -2638 | -0.11 |
| Mescavi | 35288 | 24860 | 10428 | 0.42 |
| **B. $P_2O_5$ levels (kg/ha)** | | | | |
| 60 | 37791 | 23926 | 13865 | 0.58 |
| 80 | 45036 | 24832 | 20204 | 0.81 |
| 100 | 47608 | 25822 | 21786 | 0.84 |

JBSC 3 and JBSC 1. Economic data presented in Table 2 reveal that amongst genotypes, the maximum gross returns (Rs. 53,236/ha), net return (Rs. 28,376/ha) and B : C ratio (1.14) were fetched with JBSC 4 closely followed with JBSC 2.

## Effect of Phosphorus Levels

Data presented in Table 1 reveal that the maximum number of shoots/m$^2$ (594.22) was recorded with the application of 100 kg $P_2O_5$/ha which was significantly superior over the application of 60 kg $P_2O_5$/ha but on a par with 80 kg $P_2O_5$/ha. The highest plant height (78.00 cm) was recorded with the application of 100 kg $P_2O_5$/ha which was on a par with 80 kg $P_2O_5$/ha but significantly superior over the application of 60 kg $P_2O_5$/ha. The highest leaf : stem ratio (0.61) was recorded with the application of 100 kg $P_2O_5$/ha which was on a par with 80 kg $P_2O_5$/ha but significantly superior over 60 kg $P_2O_5$/ha. Highest green fodder yield (380.86 q/ha) was recorded with the application of 100 kg $P_2O_5$/ha which was on a par with 80 kg $P_2O_5$/ha but significantly superior over 60 kg $P_2O_5$/ha. Highest dry matter yield (34.26 q/ha) was recorded with the application of 100 kg $P_2O_5$/ha which was on a par with 80 kg $P_2O_5$/ha but significantly superior over 60 kg $P_2O_5$/ha. Fresh forage yield was significantly affected by phosphorus and potassium. The highest fresh forage yield was recorded in the plots with 60 kg P $ha^{-1}$ x 30 kg K $ha^{-1}$, while the lowest value was observed in the control plots. 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 maximum crude protein (18.38%) was estimated with the application of 80 kg $P_2O_5$/ha followed by 100 kg $P_2O_5$/ha and 60 kg $P_2O_5$/ha, respectively. The maximum crude protein yield (6.20 q/ha) was estimated with the application of 100 kg $P_2O_5$/ha followed by 80 kg $P_2O_5$/ha and 60 kg $P_2O_5$/ha, respectively. Data of the economics presented in Table 2 reveal that amongst different phosphorus levels, the maximum gross returns (Rs. 47,608/ha), net returns (Rs. 21,786/ha) and B : C ratio (0.84) were fetched with the application of 100 kg $P_2O_5$/ha closely followed by 80 kg $P_2O_5$/ha.

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