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Original Article

Effect of Bio-Fertilizers on Productivity and Profitability of Berseem (*Trifolium Alexandrinum*) in *Tarai* Region of Western Himalaya

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Abstract

Field experiment was carried out at Norman E. Borlaug Crop Research Centre, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India during Rabi season of 2015-16 to study the effect of biofertilizers on productivity of berseem (*Trifolium alexandrinum)* in *Tarai* region of Western Himalayas. The experiment site was sandy loam in texture with soil pH (7.6), medium in organic carbon (0.848), nitrogen (278.48 kg/ha), phosphorus (27.7) and potassium (232.8 kg/ha). The experiment consisted of 7 treatments i.e. T_1-Control, T_2-Seed treatment with Azotobacter @2ml/kg seed, T_3-Seed treatment with Phosophobacter @ 2ml /kg seed, T_4-Seed treatment with Azotobacter @3ml/kg seed, T_5-Seed treatment with Phosphobacter @ 3m/kg seed, T_6-Seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml /kg seed and T_7- Seed treatment with mixture of Azotobactor @3ml + Phosphorbacter @ 3ml /kg seed and replicated thrice in randomized block design**.** All treatments were fertilized with 30 kg N, 60kg P_20_5 and 40 kg K_20/ha before drilling of seed.

Significantly higher plant height of berseem was recorded under seed treatment with mixture of Azotobacter and Phosphobacter @ 2ml/kg seed of each biofertiliser. Maximum number of plants per meter row length was recorded under seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml/kg seed. The green, dry fodder yield, gross returns, net return and B:C ratio were not affected significantly by biofertilisers, however the highest values were recorded under seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml/kg seed followed seed treatment with Azotobacter @ 3ml/kg seed. The seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml/kg seed gave 12.1, 12.4 and 13.4% higher green fodder yield, gross return and net return, respectively than control. Therefore it may be concluded that seed treatment with mixture of Azotobacter @ 2ml+ Phosphobacter @ 2ml/kg seed may be recommended for boosting the productivity and profitability of berseem in Tarai region of Western Himalayas.

Keywords

Bio-fertilizers; Berseem; Azotobacter; Phosphobacter; Productivity; Profitability.

Introduction

Berseem (*Trifolium alexandrinum*) is the most important fodder crop of India in Rabi season. It is widely grown in different parts of India but mainly in Northern India under irrigated conditions. In present scenario, the main focus is to avert increasing production cost with new innovations with low cost technologies. A number of agriculturally important microbes have been identified and proved its utility for bio-stimulation, plant nutrition, bio suppression and bio-remediation (Montano *et al*., 2014). The biofertilizers though eco-friendly, easy to apply and low cost technology are very effective to improve the crop productivity either by increasing root growth or secretion of plant growth hormones or combined effects facilitating more nutrient uptake (Okon *et al*., 1998). Presently number of beneficial microbes are available in the market and farmers can access easily. These potentialities of these microbes have been proved well in different agro-climatic conditions. Therefore the present investigation was carried out to study the effect of bio-fertilizers on

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productivity and profitability of berseem (*Trifolium alexandrinum*) in *Tarai* region of Western Himalayas.

Materials and Methods

Field experiment was carried out at Norman E. Borlaug Crop Research Centre, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India during Rabi season of 2015-16 to study the effect of biofertilizers on productivity of berseem (*Trifolium alexandrinum)* in *Tarai* region of Western Himalayas**.** The experiment site was sandy loam in texture with soil pH (7.6), medium in organic carbon (0.848), nitrogen (278.48 kg/ha), phosphorus (27.7) and potassium (232.8 kg/ ha). The experiment consisted of 7 treatments i.e. T_1-Control, T_2-Seed treatment with Azotobacter @ 2ml/kg seed, T_3-Seed treatment with Phosophobacter @ 2ml /kg seed, T_4-Seed treatment with Azotobacter @3ml/kg seed, T_5-Seed treatment with Phosphobacter @ 3m/kg seed, T_6-Seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml /kg seed and T_7- Seed treatment with mixture of Azotobacter @3ml + Phosphorbacter @3ml /kg seed and replicated thrice in randomized block design. All treatments were fertilized with 30 kg N, 60 kg P_20_5 and 40 kg K_20/ha before drilling of seed. The biofertilisers i.e. Azotobacter and Phosphobacter were used for seed treatment of berseem and the seed was dipped in different solutions as per the treatments for 30 minutes and later the seeds were dried in shade before sowing.

Results and Discussion

The plant height and no of plants per meter row length were significantly affected by seed treatment of biofertilisers (Table 1). Significantly higher plant height of berseem was recorded under seed treatment with mixture of Azotobacter and Phosphobacter @ 2ml/kg seed of each biofertiliser that remained non significant with seed treatment with Phosphobacter. Similarly, maximum no of plant per meter row length were recorded with seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml /kg seed that was significantly equal to seed treatment with Phosophobacter @ 2ml /kg seed and seed treatment Azatobacter @ 3ml/kg seed. The green and dry fodder yield were not affected significantly by biofertilisers, however highest green and dry fodder yield were recorded under seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml /kg seed followed by seed treatment with Azotobacter @ 3ml/ kg seed with 12.1 and 11.0% higher green fodder yield, respectively than control. The experimental results indicated that the seed treatments with Azotobacter @3ml/kg seed and seed treatment with Phosphobacter @ 2ml/kg seed had non-significant effect on most of the yield contributing characters as well as green and dry fodder yield of berseem. Hamzei (2012) observed higher nitrogen use efficiency with application of Azotobacter and Azospirillum with saving of 20% nitrogenous fertilizers in barley. Similarly, Chaverkar *et al*., 2013) reported that application of Azotobacter in conjunction with recommended fertilizers recorded higher grain yield and agronomic use efficiency in barley. Martins da Costa et al. (2015) reported higher tillers, total dry matter accumulation and more uptakes of N, P, Ca, Mg, S and B by application of phosphate solubilizing bacteria in rice crop.

Similarly, the gross returns, net returns and B:C ratio did not differ significantly among treatments but the higher returns i.e. gross and net returns as well as B:C ratio were obtained under seed treatment with mixture of Azotobacter @ 2ml+Phosphorbacter @ 2ml/kg seed followed seed treatment with Azotobacter @ 3ml/kg seed with 12.4 and 11.4% higher gross returns and 13.2 and 12.1% higher net returns, respectively than control (Table 2). It indicates that seed treatment with biofertilizers is beneficial and may contribute nearly 10-15% higher net returns mainly because of improving physiological processes with more production of growth hormones.

Table 1: Effect of Biofertilizers on productivity of berseem in *Tarai* region of Western Himalaya

S. N.	Treatment	Plant ht (cm)	No. of plant/m	Green fodder yield (q/ha)	Dry fodder yield (q/ha)
1	T_1= Control (30:60:40::N:P:k kg/ha)	55	63	322.39	45.56
2	T_2=Seed treatment with Azotobacter @2ml/kg seed	53	65	336.11	47.70
3	T_3=Seed treatment with Phosophobacter @2ml/kg seed	58	72	347.17	48.87
4	T_4= Seed treatment with Azotobacter @ 3ml /kg seed	56	73	357.94	50.63
5	T_5= Seed treatment with Azotobacter Phospho bactor@ 3ml/kg seed	55	68	299.45	42.03
6	T_6= Seed treatment with Azotobacter @2ml + Phosphobacter@2ml /kg seed	59	79	361.41	51.36
7	T_7= Seed treatment with Azotobacter @ 3ml + Phosphobacter@3ml /kg seed	55	70	351.64	49.39
	SEm±	**0.6**	**2.4**	**13.5**	**1.9**
	LSD (0.05)	**02**	**07**	**ns**	**ns**
	CV%	1.9	5.8	6.9	6.8

Table 2: Effect of Biofertilizers on profitability of berseem in *Tarai* region of Western Himalaya

S. N.	Treatment	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
1	T_1= Control (30:60:40::N:P:k kg/ha)	33,000	1,28,556	1,17,906	3.56
2	T_2=Seed treatment with Azotobacter @2ml/kg seed	33,150	1,34,445	123,395	3.72
3	T_3=Seed treatment with Phosophobacter @2ml/kg seed	33,150	1,38,869	127,819	3.85
4	T_4= Seed treatment with Azotobacter @ 3ml /kg seed	33,150	1,43,177	132,177	4.00
5	T_5= Seed treatment with Azotobacter Phospho bactor@ 3ml/kg seed	33,150	1,19,779	1,08,729	3.23
6	T_6= Seed treatment with Azotobacter @ 2ml + Phosphobacter@2ml /kg seed	33,250	1,44,563	1,33,479	4.02
7	T_7= Seed treatment with Azotobacter @ 3ml + Phosphobacter@3ml /kg seed	33,250	1,40,655	129,571	3.90
	SEm±	**-**	**5403**	**5412**	**0.16**
	LSD (0.05)	**-**	**ns**	**ns**	**ns**
	CV%	-	6.9	7.5	7.5

Conclusion

On the basis of experimental results, the seed treatment with mixture of Azotobacter @ 2ml + Phosphorbacter @ 2ml /kg seed gave 12.1, 12.4 and 13.4% higher green fodder yield, gross return and net return, respectively than control. Therefore it may be concluded that seed treatment with mixture of Azotobacter @ 2ml+Phosphobacter @ 2ml/kg seed may be recommended for boosting the productivity and profitability of berseem in Tarai region of Western Himalayas.

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