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Effect of inoculation on green fodder yield of berseem and persian clover at agro climatic conditions of Hazara Division Pakistan

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Abstract

Fodder is the major and cheap source of livestock feed in Pakistan. Among fodder crops, Legumes have a key role in animals feed by providing palatable and nutritious fodder. Earth atmosphere is enriched with nitrogen (78%). Some plants have ability to make use of that nitrogen utilizing a symbiotic relation with some bacteria. Berseem and Persian clovers (Shaftal) can get benefit from this ability in far better way. Keeping this factor in mind an experiment was conducted at National Tea and High Value Crops Research Institute (NTHRI) Shinkiari Mansehra in Rabbi 2016-17. In this experiment, berseem and Persian clovers was grown in factorial randomized complete block design (RCBD) in three replications. Two factors were used *viz*. crops (Berseem and Persian clovers) and inoculation (Inoculated and non-inoculated).Inoculation was done with type R inoculums. Data were collected on plant height, root length, nodulation, and biomass yield parameters at appropriate morphological and physiological stages. On subjection to statistical analysis the results revealed significances changes in biomass production and nodules formation as compared to control treatments. While comparing both crops regarding inoculation Persian clovers produced more biological yield however, more nodulation was recorded in berseem. In comparison with control inoculated Persian clovers produced 7.30 % more green fodder yield while inoculated berseem produced 4.08 % more green fodder yield. These finding recommends inoculation of berseem and Persian clover for more green fodder production.

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Introduction

Around 110 million tons of nitrogen required for the world's annual food production but only 7 million tons are supplied through organic and inorganic sources (Adjei *et al.,* 2002). Legumes crops have the ability to fix atmospheric nitrogen. Berseem clover, Persian clovers, alfalfa and vetch are common forage legumes. These crops require less inorganic fertilizer as they have developed nodules. Most of legumes have ability to convert nitrogen present in the air into ammonia through their roots, which is quickly converted into amino acids and then assimilated as protein due to its symbiotic relationship with bacteria (Daisy *et al.* 2017).

Plant root provides shelter to bacteria in gall like structure called as nodules, in return bacteria fixes atmospheric nitrogen into usable form for the plant. Soon after germination bacteria starts penetrate root hairs and the root cells multiply until, eventually, a nodule (gall-like structure) forms on the roots (Philipp and John, 2012). For the conversion of atmospheric nitrogen bacteria needs energy that comes from plant metabolism, therefore it is necessary to give small quantity of NPK as basal dose to legumes. It is also observed that in well fertilized crops bacteria do not perform effectively because plant don't have need of much nitrogen (Alves *et al*., 2004).

Berseem and Persian clovers are multi-cut crops their biomass production is far better than others. Berseem has ability to tolerate soluble salts, while Persian clovers can mitigate the effect of So^2 pollution. Fixation rates of berseem (243-357lbs/acre) far better than other winter legumes **(**Bulter and Evers. 2004**).** On an average there is reduction of 2% land area for fodder cultivation annually, there is a great need to improve fodder production through improved agronomic practices. (Sakamoto, T. and M. Matsuoka. 2004) Inoculation of legumes in appropriate way increases their nutrition through protein enrichment and total biomass production also (Zahran H.H., 1999).While comparing yield of inorganic fertilizer with inoculated berseem and Persian clovers, it is cleared that inorganic source of application gives more yield but its higher cost (Hidayatullah A., 2016) and negative effects on soil like decrease in soil organic matter is another limiting factor for its use. Microbial activity of soil improves its texture and water holding capacity (Savci S. 2012).

The aim of the present study was to investigate the response of Persian clover and berseem to Rhizobium inoculation in terms of nodulation and green fodder yield under agro-climatic condition of Hazara Regions.

Material and methods

Experimental site

The experiment was conducted at National Tea and High Values Crops Research Institute Shinkiari Mansehra. The experimental site is situated at located 18 km north of Mansehra city on the Karakoram Highway, it is located at 34°28'0N, 73°16'60E at an altitude of 1019 meters (3346 feet) in Hazara Division above 1000 m above sea level in Khyber Pakhtunkhwa, Pakistan. Experimental site receives more than 1000 mm annual rainfall and the climate of the site is temperate. Experimental site have fine silty with mixed clay loam soil. The soil pH is ranging from 5.5-6.5. The soil is very rich in micro nutrients like NPK and contains more than five percent organic matter.

Experimental materials

An experiment entitled Effect of inoculation on green fodder yield of Berseem and Persian clover was conducted at in Rabi 2016-17. This experiment was conducted in RCB design with three replications. Plot size was 3x4 meter. Seed rate, irrigations and other agronomic practices were kept same as recommended.

Experimental treatments

There were two crops Berseem and Persian clovers, grown with two different factors. Half of treatments were inoculated and half non-inoculated. Inoculation was done with type R inoculums and the species was Rhizobium trifolii, while considering the cross-

inoculums group (Mansoor *et al.*,2016).

And other half were non-inoculated all other agronomic practices were constant and according to recommendation.

Statistical analysis

Statistical analysis of the data was performed using "Statistix 8.1" analytical software (MGraw-Hill, 2008) for RCB design. Means were separated using LSD test at 0.05 level of probability (Steel and Torrie, 1980).

Results and discussion

1st Cut Green Fodder Yield

Data regarding green fodder yield of Berseem and Persian clovers as affected by inoculations presented in Fig. 1. Statistical analysis of data shows that the variation in green fodder yield was significant. Treatments which were inoculated with rhizobium trifolii produced more biomass as compared to non-inoculated. Highest green fodder yield after first cut is obtained from Persian clovers (17406kg's ha^{-1}) while less in non-inoculated (13417 kg's ha^{-1}). Almost similar trend regarding yield gap of 3000 kg ha^{-1} is found in both crops for inoculated and non-inoculated treatments. These results are in line with Bains *et al.,* 1974.

2nd Cut Green Fodder Yield

Green fodder yield after second cut taken at 60 days of sowing in all treatments as shown in Fig. 2.

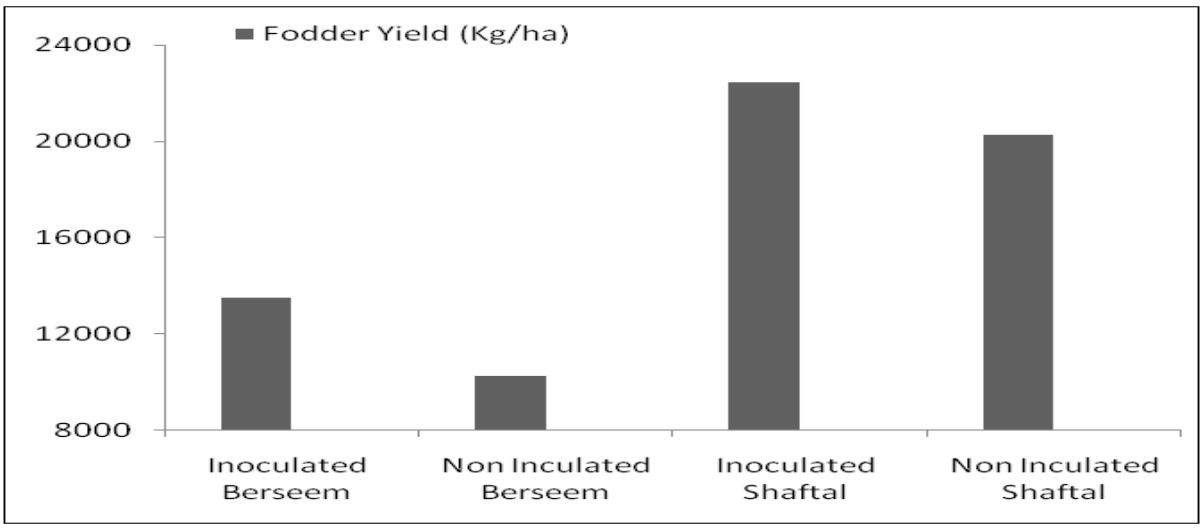

Fig. 1. Green fodder yield of berseem and Persian clovers as affected by inoculation.

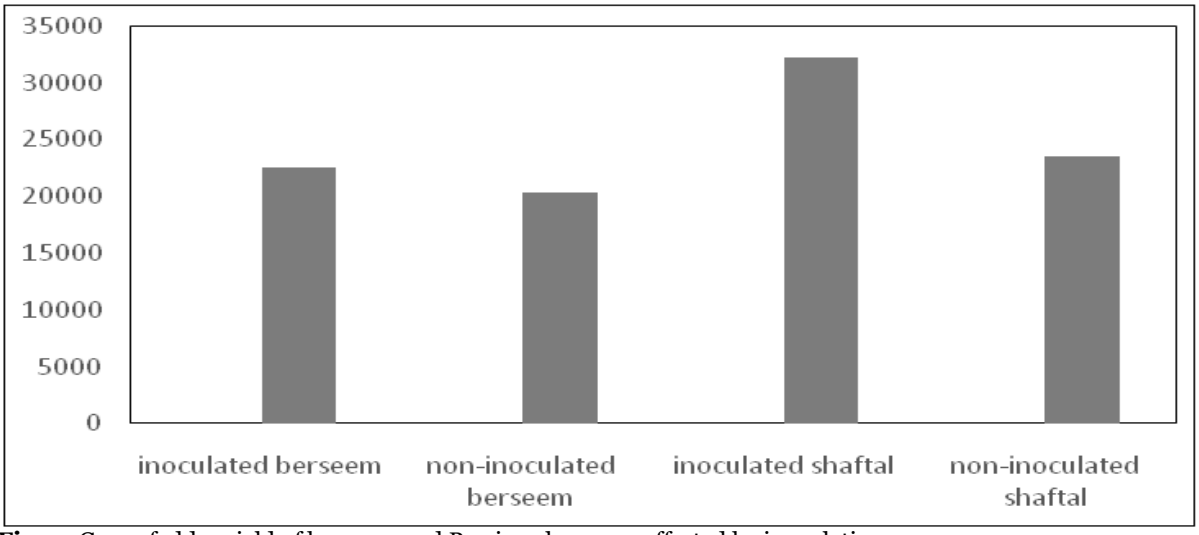

Fig. 2. Green fodder yield of berseem and Persian clovers as affected by inoculation.

Statistical analysis of data has shown that Persian clovers are performing excellent when it is inoculated. Significant yield difference of 8778 kg's ha^{-1} is found at second cut in inoculated and non-inoculated treatments. Biomass production level in inoculated treatment of Berseem is also better than non-inoculated treatment. Similar results were reported by (Bains *et al.,* 1974) and (Oliveria *et al.,* 2004).

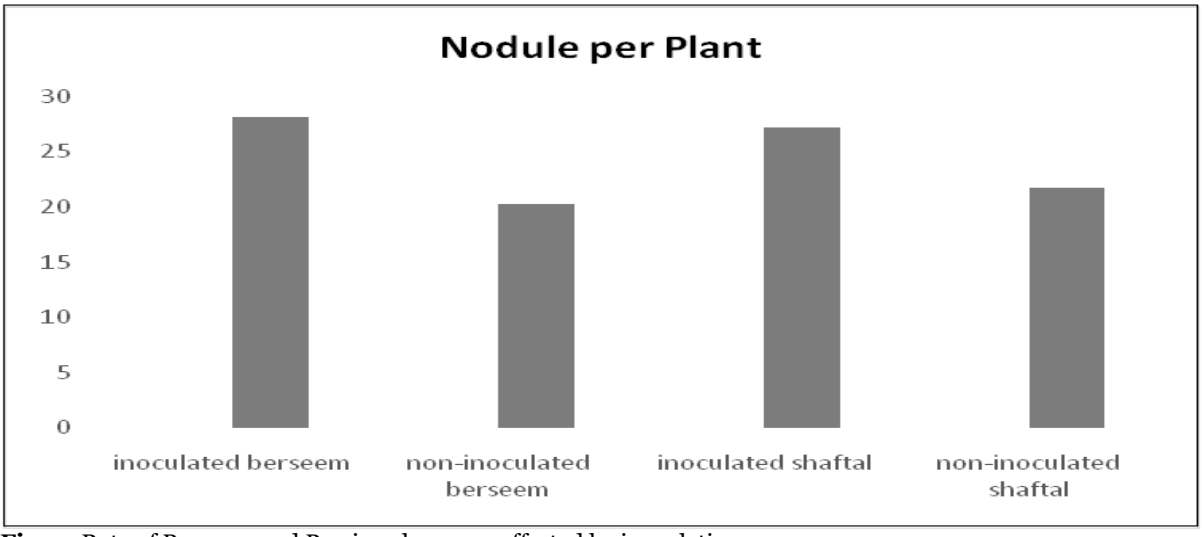

Fig. 3. Rate of Berseem and Persian clovers as affected by inoculation.

Nodulation

More number of nodules on plant root it means more nitrogen it can converts into useable form through its roots and if N supply is also increased, dry biomass, CO_2 assimilation, foliage thickness and density are significantly enhanced (Schortemeyer *et al.,* 1999). Experimental results related number of nodules per plant showed that more nodules are in inoculated treatments as shown in Fig. 03.

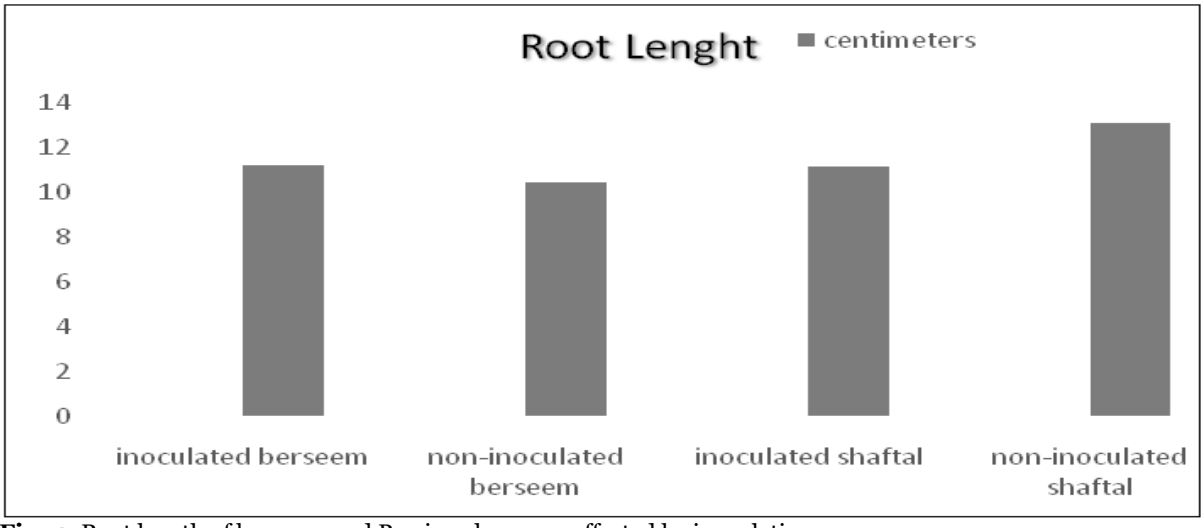

Fig. 4. Root length of berseem and Persian clovers as affected by inoculation.

There could be two reasons for this either cross inoculum group of bacteria were not presentpreviously in the soil or environmental conditions do not suits long term persistence of that bacteria in that field. Highest number of average nodule is 28 which are found on inoculated berseem. Its average green fodder yield after two cuts is also highest. (Rodri´guez-Navarro *et al.,* 1999) and (Shaharoona *et al.,* 2006) both noted with the same situation in their experiments.

Root Length (cm)

Average data regarding root length is presented in Fig.04. Statistical analysis of mean data shows that highest root length is of non-inoculated Persian clovers but its green fodder yield is less as compared to others inoculated treatmentswhile the lowest root length is of non-inoculatedBerseem. By comparing effect of inoculation in both crops berseem and Persian clovers they have same root length (11cm) these results match with Indian scientist (Ravikumar, 2012).

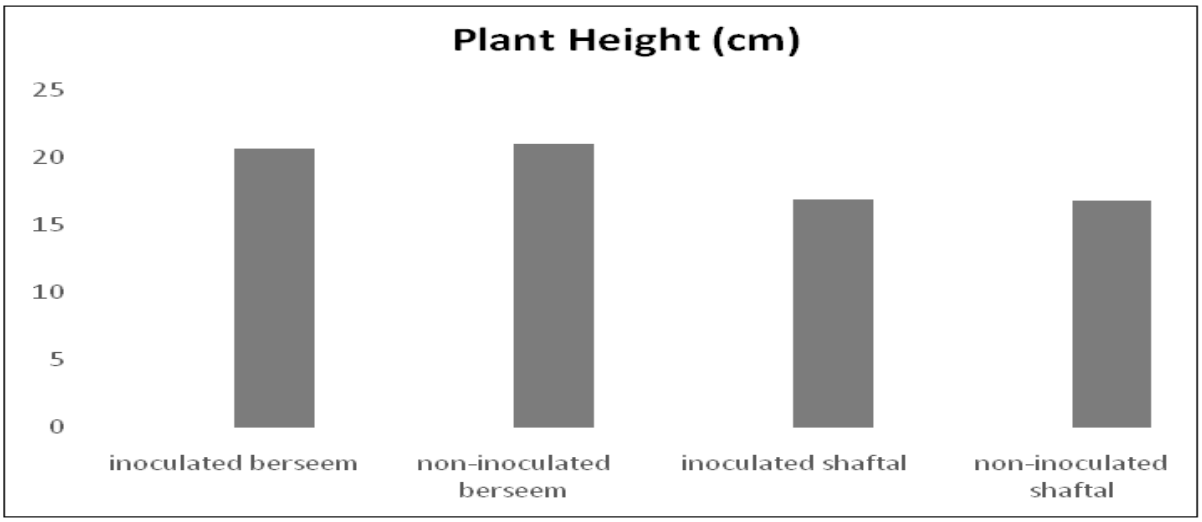

Fig. 5. Root length of berseem and Persian clovers as affected by inoculation.

Plant height (cm)

Plant height has significant effect on biomass and green fodder production. Data regarding average plant height of inoculated and non-inoculated treatments is presented in Fig. 05. Results show that more height is attained by non-inoculated berseem and lowest height is of non-inoculated Persian clovers.

Overall mean values indicated that more plant height is found in berseem as compared to Persian clovers crop.

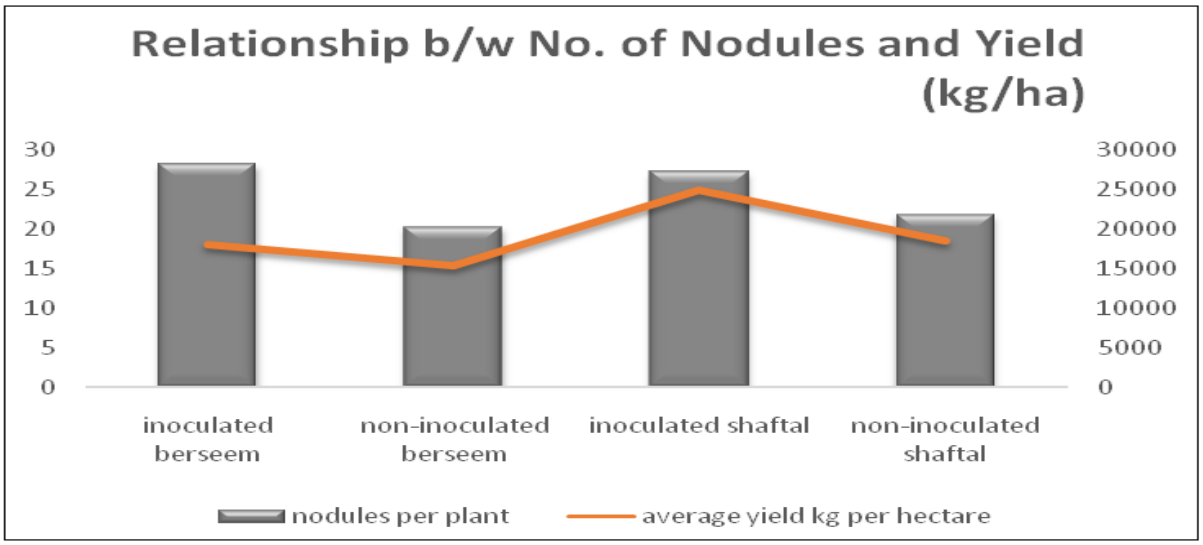

Fig. 6. Relationship b/w No. of nodules and yield of berseem and Persian clovers as affected by inoculation.

The height of non-inoculated berseem is more but its biomass production is far less than inoculated treatment. These results are in contrary with (Sakamoto and Matsuoka, 2004).

Nodules and biomass relationship

Number and type of nodules has its direct relationship with plant biomass production as shown in Fig. 06. It is seen that both inoculated crops have more number of nodes and their biomass mass production is also high as compared to non-inoculated regime. Statistical analysis of mean data after two cuts shows that highest numbers of nodules are there in inoculated Persian clovers but highest average green fodder yield is that of berseem. Significant yield difference is also seen un-inoculated and non-inoculated treatments. This relationship is also concluded by (Sayar M. S., *et al* 2012).

Conclusion

It is concluded from the preset study that inoculation of legumes fodders produced more biological yield and nodulation compared to control. Inoculation not only increase crops productivity but also enhances soil fertility. Thus, inculcation of berseem and Persian clovers is recommended for more green fodder production.

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