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# Effect of inoculations of *Rhizobium leguminosarum* on germination & yield of Field Pea (*Pisum sativum*) under temperate conditions of Kashmir

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**Abstract**
A field experiment was conducted during the year 2011-2012 at Krishi Vigyan Kendra- Bandipora, SKUAST-Kashmir to study Effect of inoculations of *Rhizobium leguminosarum* on germination & yield of Field Pea (*Pisum sativum*) under temperate conditions of Kashmir with four treatments of *Rhizobium* @ 0 Kg/ha (Control), 1.25 Kg/ha, 2.50 Kg/ha and 2.75 Kg/ha through inoculations of *Rhizobium leguminosarum*. The significant results were obtained with Application of Rhizobium at 3.75 Kgs/ha resulted in Approx. 80% germination & the maximum yield viz; 14.0 qt/ha was recorded as compared to the Farmers Practice where farmers do not use inoculations of *Rhizobium*. Farmer was satisfied so far as Subsequent germination & yield obtained were redressed during the conduct of on farm trial. The Farmers were suggested for applications of rhizobium inoculations on the farmers field As far as Economics is concerned, the farmers practice obtained the Net Return of (Profit) in Rs. 3692 Rs / ha as compared with the application of Rhizobium @ 3.75 Kgs/ha obtained the Net Return of (Profit) in Rs. 28667/ha with B:C ratio of 3.15.

**Keywords:** Pea, *Rhizobium leguminosarum*, yield and germination

## Introduction
Pea (*Pisum. sativum*) is the popular pulse crop of India. Pea is an annual plant with a life cycle of one year. It is a cool-season crop grown in many parts of the world. It is an excellent source of dietary protein and can play an important role in fulfilling the nutrient requirements of rapidly increasing population. It is highly nutritive and contains 22.5% protein, 1.8% fat, 62.1% carbohydrates besides a rich source of calcium, iron and other micronutrients, fibre and vitamins. There are two types of peas garden pea (*P. sativum var. hortense*) and field pea (*P.sativum var. arvense*). India occupy fourth position in area (10.53 %) and 5th position in pea production (6.96 %) (FAO Stat., 2014). In India pea is grown over an area of 1.15m ha with a production of about 1.03 m tons.

Production of pulses in the country is far below the requirement to meet even the minimum level per capita consumption. The per capita availability of pulses in India has been continuously decreasing which is 32.5 gm/day against the minimum requirement of 80gm/day per capita prescribed by Indian Council of Medical Research (ICMR). In order to bridge this gap it is essential to provide balanced nutrition to crops in order to get higher yield. Pea being a legume crop the major portion of N requirement of the crop is met through biological nitrogen fixation (BNF). Pea (*Pisum sativum*) can fix upto 55-75 kg N/ha after seed inoculation with *Rhizobium leguminosarum*. The bacteria has a symbiotic relationship with the roots of the pea. Keeping this in view the present investigation was undertaken to study the effect of inoculations of *Rhizobium leguminosarum* on germination and yield of field pea under temperate conditions of Kashmir in Krishi Vigyan Kendra (KVK) Bandipora SKUAST-Kashmir.

## Materials and methods
A field experiment was conducted during the year 2011-2012 at Krishi Vigyan Kendra-Bandipora, SKUAST-Kashmir to study Effect of inoculations of *Rhizobium leguminosarum* on germination & yield of Field Pea *(Pisum sativum)* under temperate conditions of Kashmir. The study as conducted in order toi address the lower yielkds of field pea in the farmers filed.Two trails were set up in the field.The experiment consisted of four different treatments *Rhizobium* T1 *rhibozium*@ 0 Kg/ha, this treatment does not contain *rhibozium* and was kept as a control.

The other three treatments i.e T2, T3 & T4 conatined varied concentrations of rhibozium@1.25 Kg/ha, 2.50 Kg/ha and 2.75 Kg/ha respectively through inoculations of *Rhizobium leguminosarum*. Pea seeds of standard quality were bought from the credible sources, and the whole seed lot was divided into four equal parts.the first part was not inoculated with the rhibozium and represented control. The other 3 parts were inoculated with the desired quantity of the rhibozium as presnt in the treatments T1, T2 & T3. The innoculum was prpoperly mixed in order to ensure the uniform coating of the rhibozium over the seeds. The crop was cultivated as per the package of practices recommended by SKUAST-K in pea cultivation. The experimental crop was grown under irigated conditions as per the recommended agronomic practices. The effect of treatments was evaluated on pooled basis on growth, yield attributes, yield and economics. Every effort was taken to maintain homogeneity of plots and to reduce the experimental error.

**Table 1:** Showing details of the crop and experiment.

| Crop | Farming system | Problem diagonosed | Name of OFT | No of trails | Technology assessed | Parameter of assesment |
|---|---|---|---|---|---|---|
| Field pea (*Pisum sativum*) | Rainfed | Lower yields | Effect of inoculations of *Rhizobium leguminosarum* on germination & yield of Field Pea. *(Pisum sativum)* | 2 | Varying doses of Rhizobium inoculations & Subsequent germination & yield. | T0: No treatment<br>T1: 1.25 Kg/ha<br>T2: 2.50 Kg/ha<br>T3: 3.75 Kg/ha<br>Note: Recommendations of SKUAST- K with respect to seed rate & fertilizer application was followed in all the treatments |

## Results and Discussion

### Effect of rhibozium

### On germination percentage and yield

The technology assessment of the varied doses of rhibozium inoculations and its subsequent effects on yield and germination percentage of field pea was carried out and it was found that there was a significant increase in the germination percentage and yields of the pea in the trails with increasing in the concentration of rhibozium. These bacteria have a Nitrogenase enzyme that combines gaseous nitrogen with hydrogen to produce ammonia, which is then further converted by the bacteria to make their own organic compounds. They live in the root nodules of legumes. Here they form mutualistic relation relationship with the plant, producing ammonia in exchange for carbohydrates.

**Table 2:** Particulars showing the details of treatments and results obtained.

| S.no | Treatments | Rhibozium @ | Germination (%) | Yields(q/ha) |
|---|---|---|---|---|
| 1 | T1 | 0kg/ha | 24.8 | 5.6 |
| 2 | T2 | 1.25 kg/ha | 49.6 | 6.4 |
| 3 | T3 | 2.5 kg/ha | 65.20 | 10.2 |
| 4 | T4 | 3.75kg/ha | 79.80 | 14.0 |

Pooled data presented in the table 1 indicates that there was a significant increase in the germination percentage and yields with the increased inoculation of rhibozium. In T1 (control) which implies the farmers practice only 24.8% germination and 5.6 q/ha yield was recorded. In T2 which contained rhibozium @1.25kg/ha germination percentage almost doubled compared to control to about 49.6% and the yield in T2 was 6.4q/ha. Germination percentage of 65.20% and 10.2q/ha yields were recorded with the application of T3 containing rhibozium @2.50kg/ha. The highiest yield and germiunation percentage was recorded in T4 which containted rhibozium @3.75kg/ha. The significant results were obtained with Application of Rhizobium @ 3.75 Kgs/ha resulted in Approx. 80% germination & the maximum yield viz; 14.0 qt/ha was recorded as compared to the Farmers Practice where farmers do not use inoculations of *Rhizobium*. Farmer was satisfied so far as Subsequent germination & yield obtained were redressed during the conduct of on farm trial. The Farmers were suggested for applications of rhizobium inoculations on the farmers field.

**Table 4:** Particulars showing results and feedback of farmers

| Feedback from the farmer | Any refinement done | Results of assessment | Remarks |
|---|---|---|---|
| Farmer satisfied with the experiment | OFT needs to be repeated during the ensuing Rabi season with a few more treatments | Application of Rhizobium at 3.75 Kgs/ha resulted in Approx. 80% germination & the maximum yield viz; 14.0qt/ha was recorded | OFT needs to be repeated during the ensuing Rabi season with a few more treatments |

The farmers were satisfied with the results of the OFT but the major questions asked during the interaction session included the source of rhizobium innoculum, proper technique regarding of handling, care and operation etc.it was observed that among the farmers who were ready to adopt the innovation were having medium to high extension contacts, exposure and educational qualification. But before the widespread diffusion of the this innovation the experts were of the opinion that the OFT should be repeateded during the rabi season with few more treatments in order to reduce the error and motivate more farmers towards adopting the innovation.

### On economics

As far as Economics is concerned, here the economics of two treatments T0 (Control) is compared with the best practice i.e. T3 the particulars regarding the cost of cultivation and net returns are presented in table 3.

**Table 3:** Economics analysis of the experimental plots and the farmers practice.

| S.no | | T3 (Best practice) | T0 (farmers practice) |
|---|---|---|---|
| 1 | Yields (Q/ha) | 14.0 | 5.6 |
| 2 | Total cost of cultivation (Rs/ha) | 13300 | 12800 |
| 3 | Gross returns (Rs/ha) | 42000 | 16492 |
| 4 | Net returns(Rs/ha) | 28700 | 3692 |
| 5 | B.C ratio | 3.15 | 1.28 |

The yields obtained in the pea plots with treatment T0 & T3 was 5.6kg/ha and 14.0kg/ha respectively. The highiest yields were recoredeed in treatment T3 (Rhizobium @3.75kg/ha) and it was due to the highiest germination percentage of79.80%inT3and also the rhibozium inoculation increased the nitrogen fixation capacity of the crop. The cost of cultivation slightly increased with the application of increased dosoes of rhibozium and was highiest in T3.All the other factors were kept constant during the study which resulted in almost similar costs of cultivation in all the plots. The yields from the T3 were more than double as compared with the control. The farmers practice obtained a yield of 5.6q/ha the Net Return of (Profit) in Rs. 3692 Rs / ha as compared with the application of Rhizobium @ 3.75 Kg/ha obtained the Net Return of (Profit) in Rs. 28667/ha with B:C ratio of 3.15. The farmers were satisfied with the performance of the trail and were ready to adopt the innovation in their fields

## Conclusion

The productivity enhancement of pea with the application of rhibozium over traditional method of field pea cultivation created greater awareness and motivated the other farmers to adopted appropriate production technology of field pea in adopted district. The selection of specific technology like improve variety, seed treatment, seed inoculation with biofertilizers *i.e. Rhizobium*, recommended dose of Phosphorus, Pre-emergence weed management and plant protection measure were undertaken in a proper way. The study was effective was effective in changing attitude of farmers towards pulse cultivation. Cultivation of pea plots with improved technologies has increased the skill and knowledge of the farmers. The study also helped in replacement of local unrecommended varieties with improved recommended varieties. This also improved the relationship between farmers and scientist and built confidence between them.

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