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Influence of *Rhizobium* Inoculation on Yield, Growth Attributes and Soil Fertility in Garden Pea

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ABSTRACT

The field experiment was conducted during *rabi* 2020-2021 at experimental farm of Krishi Vigyan Kendra, Rohru district Shimla to study the effects of *Rhizobium* application in pea crop on its yield, yield attributes and soil nutrient status. The experiment comprised of five treatments *i.e.,* Farmers' practice (T1), recommended dose of fertilizers (T2), 100 % NPK (T3), 75% N+ 100% PK+ *Rhizobium* (T4) and 60% N+100% PK+ *Rhizobium* (T5). The experiment was laid out in a randomized block design with three replications. The highest number of pods per plant, pod length, pod weight and yield were recorded in T2 whereas highest number of seeds per pod was found in T4. Results revealed that 25per cent reduction in chemical nitrogenous fertilizer in combination with biofertilizers (T4) give significantly similar yield, number of pods per plant, pod length, seed per pod and pod weight in comparison to T2.

Key Words: Integrated nutrient management, Nutrients, Pea, Rhizobium, Soil, Yield.

INTRODUCTION

Nitrogen is a major nutrient that is required in relatively large amount for proper growth and development of plants. It is one of the limiting nutrients in Indian soils. Even though nitrogen is about 79% in the atmosphere, it requires to be fixed by certain microorganisms. Biofertilizer is a substance that contains living organisms that can either fix atmospheric nitrogen or solubilize soil phosphorus or produce growth hormones for improving the soil fertility and as an alternative to reduce use of chemical fertilizers. Biological nitrogen fixation is a process that fixes atmospheric N in certain plants with the help of micro-organism either through symbiotic or non-symbiotic relationship. This biologically and symbiotically fixed N decreases dependence on chemical fertilizers and therefore, reduces cost of cultivation and sustains soil health. *Rhizobium* is the most important genus of the symbiotic microorganisms in leguminous crops. Symbiotic relationship between pea crop and *Rhizobium* has been widely studied by many researchers (Kumari *et al*, 2012; Bai *et al*, 2016; Muniz *et al*, 2017). Pea (*Pisum sativum L.*) is one of the most important pulse crops that is popularly grown as vegetable in Shimla district of Himachal Pradesh. It is an integral part of apple orchard cultivated during the *rabi* season. The average productivity of the state is comparatively higher than the national average productivity (Anonymous, 2018). Nitrogen fixation is sensitive to nitrogen level in soils and therefore, the objective of this study was to compare the effects of Rhizobium inoculation and nitrogen fertilizers on growth and yield of garden pea.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season 2020-2021 at the experimental farm of Krishi Vigyan Kendra, Rohru district Shimla. The site of the experimental farm is situated on 31.2151º N latitude and 77.7230º E longitude at 1525 m above the sea level. The experiment comprised of five treatments (Table 1) i.e Farmers' practice (T1), recommended dose of fertilizers (RDF, T2), 100 per

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Table 1 Details of treatments.

Sr. No	Treatment	
1.	Farmers Practice (no application of fertilizers)	T1
2.	Recommended dose (RDF) i.e., 100 kg/ha urea, 375 kg/ha SSP and 100 kg/ha MOP + 200 q/ha FYM	T2
3.	100% NPK of RDF without FYM application	T3
4.	75% N + 100% PK of RDF+ Rhizobium seed treatment	T4
5.	60% N + 100%PK of RDF +Rhizobium seed treatment	T5

cent NPK (T3) of RDF, 75% N+ 100per cent PK+ *Rhizobium* (T4) and 60per cent N+100per cent PK+ *Rhizobium* (T5). The experiment was laid out in a randomized block design with three replications. Application of FYM, P and K source of fertilizers were done during land preparation. Nitrogen application was done in split doses i.e., the first half applied during land preparation and the second dose was again divided equally and was applied after a month of sowing and the last dose applied after flowering. *Rhizobium* inoculant was developed by Department of Soil Science and Water Management of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan. For seed treatment, sticker solution was prepared and pea seeds were mixed thoroughly and then air dried. The seed coated with rhizobial cells were then sown in the field.

Plant parameters such as number of pods per plant, pod length, number of seeds per pod and pod weight were recorded from 10 random plants and yield was recorded on plot basis. After harvest, soil samples were collected for analysis of soil parameters *viz.,* soil reaction (pH), organic carbon and soil available nitrogen (N), phosphorus (P) and potassium (K). The methods used were potentiometric method for soil pH (Jackson, 1973), Walkey and black titration method for soil organic carbon (Walkley and Black, 1934), soil available N by extraction using alkaline $KMnO_4$ (Subiah and Asijah, 1956), extraction by 0.5 M $NaHCO_3$ colorimetric method for soil available P (Olsen *et al,* 1954) and extraction by 1 N NH_4OAc flame photometric method for soil available K (Jackson, 1973).

The data were subjected to statistical analysis using the technique of analysis of variance for randomized block design for interpretation of results as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect on yield attributes

The effect of different nutrient management on growth parameters is shown in table 2. The number of pods per plant, pod length, pod weight was found highest in T2 (100% NPK + FYM). The highest number of pods per plant in T2 was found significantly similar with T3 (100 % NPK) and T4 (*Rhizobium* treatment + 75% N + 100% PK). Similarly, there was no significant differences between T2, T3 and T4 with respect to pod length and pod weight. The seeds per pod was found maximum in T4 with the value of 10.13 and was significantly at par with T2, T3 and T5. The results showed that reduction of chemical fertilizer N by 25per cent can be substituted by application of biofertilizers. Similar findings were reported by Qureshi *et al* (2015) and Sharma *et al* (2016).

Effect on yield

The highest yield (184.7 q/ha) was recorded in T2 which was statistically similar with treatment T3 and T4 and lowest yield in T1 (166.7 q/ha). Application of *Rhizobium* along with chemical fertilizer improved the yield and other yield attributing characters. Thus, it can be concluded that chemical fertilizers can be replaced by integrated use of chemical fertilizers and biofertilizers for yield. The findings agree with the finding of Sharma

Table 2 Effect of integrated nutrient management on yield attributes and yields of garden pea.

Treatment	Number of pods per plant	Pod length (cm)	Seed per pod	Pod weight (g)	Yield/ ha (q/ha)
T1	13.47	8.77	6.60	4.86	166.67
T2	17.80	11.63	10.07	6.59	184.67
T3	16.13	10.43	9.20	6.02	178.67
T4	16.27	10.13	10.13	5.97	180.67
T5	14.40	9.53	8.87	5.26	175.67
CD	1.80	1.59	1.53	1.06	8.71

et al (2016); Kumari *et al* (2012) and Qureshi and Bashir (2016).

Effect on soil nutrient status

Soil reaction ranged between 5.60 to 5.80 and all treatments were significantly similar. Soil organic carbon was found highest in T2 followed by T5, T4, T1 and T3. The lowest value in T3 must be due to zero application of organic manure. Data also revealed that RDF treatment recorded the highest value of soil available N, P and K. The maximum value of soil available N, P and K was 481.0, 46.7 and 271.3 kg/ha respectively. Combined application of chemical fertilizers and rhizobium improved the soil nutrient status in comparison to farmers' practice. The soil available N, P and K in RDF treatment were statistically at par with T3 and T4. This proved that chemical fertilizers can be compensated by *Rhizobium* application. This finding was in close agreement with the study of De *et al* (2006); Sharma *et al* (2015); Singh *et al* (2016) and Bai *et al* (2016).

CONCLUSION

The results revealed that combined application of chemical fertilizers and biofertilizers has positive effect on yield, yield attributes of pea and soil nutrient status. Application of *Rhizobium* can reduce dependence on chemical fertilizers. It may be concluded that integrated nutrient management can be considered one of the best management practices to improve yield and soil fertility.

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Table 3 Effect of integrated nutrient management on soil nutrient status.

Treatment	pH	SOC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T1	5.67	0.67	313.7	28.0	243.3
T2	5.67	0.99	481.0	46.7	271.3
T3	5.60	0.53	480.7	41.3	266.7
T4	5.80	0.74	397.0	41.0	269.3
T5	5.80	0.75	293.0	42.3	266.0
CD	NS	0.25	94.2	8.8	15.9

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