1. INTRODUCTION

Vegetables play a vital role in the health and nutritional security of human population. India is the largest producer of vegetables only next to China with an estimated annual production of about 82 m t from an area of 6.2 m ha. It is the vast country bestowed with wide range of agro-climatic conditions, thus enabling to grow both tropical and temperate vegetables. But per capita availability of vegetables in our country is 210 g day$^{-1}$, which is less than the dietary requirements of 300 g day$^{-1}$ (Arya and Prakash, 2002).

Pea (Pisum sativum L.) is an important legume crop of India. It belongs to the family of leguminosae and sub-family of papilionacea having chromosome numbers of 2n = 14 (Das and Kalloo, 1970). It is used both as grain legume referred as field pea (Pisum sativum Linn. var. arvense) and vegetable referred as garden or vegetable pea (Pisum sativum Linn. var. hortense). It is cultivated as a winter crop in the plains and as a summer crop on the hills of northern India. It is consumed either as a fresh succulent vegetable or in processed form.

The green pods of pea from hills are available at a time when these can not be grown in the plains due to high temperature. Consequently, the green pea pods are sold at a higher premium bringing lucrative returns to the growers. Moreover, the consumers have special preference for hill grown peas because of their characteristic flavour, sweetness and freshness.

Pea is grown for its green pods containing immature seeds. Green peas are an all time favourite vegetable; as these are amicably mixed with
other vegetables such as potatoes, cauliflower, cabbage, spinach etc., as well as with *pulao* and cheese. The delicious fried peas and pea soup are very well consumed by large number of families throughout India and elsewhere in the world. It has a good market potential in canned, frozen and dehydrated forms to be used during the off-seasons. The mature seeds are used as pulse or *dal*.

Pea is highly nutritious food. The fresh pea contains about 72.0 per cent moisture. It consists of protein, carbohydrate, fiber, vitamin A, vitamin C, phosphorus, potassium, calcium, magnesium, and sulphur (*Pandita and Pratap, 1986*).

Globally, vegetable pea occupies an area of 0.87 m ha with a total production of 7.094 m t and productivity of 8.2 t h⁻¹. In India, it is grown on 0.2726 m ha area with annual production of 2.712 m t and productivity of 9.9 t h⁻¹ leading to higher productivity of green pea than the world average (*N. H. B., 2001*).

Vegetable pea constitutes about 4.5 percent of the total area contributing to 2.9 percent of total vegetable production in India. Major states producing vegetable pea are Uttar Pradesh, Bihar, Punjab, Himachal Pradesh, Orissa and Karnataka. The state of Uttar Pradesh alone accounts for 0.1504 m ha area (55.2 %) under vegetable pea and producing 1.884 m t (69.5 %) with a productivity of 12.5 t ha⁻¹. However, Uttarakhand, a newly state carved out of Uttar Pradesh, shares only 0.0116 m ha area and produces 0.069 m t with a productivity of only about 6.0 t ha⁻¹ of vegetable pea (*Arora and Singh, 2002*).

Vegetable pea, being a legume crop, is capable to fix atmospheric nitrogen symbiotically in its nodules on the roots by a specific rhizobial bacterium called *Rhizobium leguminosarum*. A legume crop, having
effective root nodules not only meets its nitrogen needs, but also enhances the growth of subsequent crops through improvement in the fertility status of the soil.

Nodulation in legumes plays an important role in the fixation of atmospheric nitrogen. Since nitrogen fixation is dependent on the formation and maintenance of nodules; hence, the degree of nodulation in legumes is used as a measure of symbiotic activity.

The association between legume crop and *Rhizobium* bacteria can supply 80-90 per cent of the total N requirement of the crop and increased the grain yields by 10-15 per cent following inoculation (Tilak and Singh, 1994). It has been observed that seed inoculation with effective *Rhizobium* improves nodulation as well as crop yield (Sharma et al, 1999).

Presence of nodules on plant roots does not necessarily mean that sufficient nitrogen is being fixed for the maximum benefit of the host plant. The efficiency of symbiosis varies with the *Rhizobium* strain, host plant and also governed by soil and environmental factors (Vincent, 1974). Moreover, nodulation is dependent on the genetic interaction between the host legume crop and *Rhizobium* strains (Karahne et al, 2001).

In India, pea is being cultivated for a quite long-time. Therefore, the rhizobial strains nodulating this crop leads to their build up in soils. These native rhizobial strains compete with rhizobial strains applied through inoculums. Under such situations, inoculum’s strains applied on seed at recommended rates may not be sufficient to compete successfully with indigenous rhizobia for nodule formation. Hence, increasing the rate of rhizobial inoculums perhaps can solve this problem. Sometimes, high doses of inoculums beyond the particular level did not enhance nodulation, but result in early nodulation (Weaver and Frederick, 1974). In addition, if the
soil is poor in specific rhizobial strains for a legume or their population is sparse to form nodules; then, it becomes necessary to inoculate the seeds or soil with suitable bacteria for achieving better nodulation and higher yields.

Considering the importance of rhizobial inoculation in legume production and improvement of soil fertility as well as the lesser area, low production and poor productivity of vegetable pea in Uttarakhand; it is quite imperative to evaluate the varieties of vegetable pea for native *Rhizobium* in soil (uninoculated) as well as for applied *Rhizobium* on seeds (inoculated) for nodulation and yield parameters.

In view of the above, present investigation entitled, “**Varietal response of vegetable pea (Pisum sativum L.) to rhizobial inoculation for nodulation and yield traits**” was conducted for two consecutive years during Rabi season of 2004-05 and 2005-06 under irrigated field conditions, at the research farm of R. M. P. (P. G.) College Gurukul Narsan, district Haridwar. It is lying in the plain region of Garhwal division of Uttarakhand state. The specific objectives of the study were:

- To evaluate the genetic variability in vegetable pea.
- To estimate the response of pea varieties to rhizobial inoculation on nodulation, plant growth, and yield parameters.
- To study the interrelationship between growth, nodulation, yield and biochemical parameters.
- To suggest a suitable dose of *Rhizobium* inoculation in vegetable pea.