CHAPTER- I
INTRODUCTION

India is the largest producer of pulses, accounting for about 25 per cent of the global share. Being an inseparable ingredient in the diet of the majority of vegetarian population and mainstay of sustainable crop production, pulses continue to be an important component of the rainfed agriculture, since time immemorial. About a dozen pulse crops viz, chickpea, pigeonpea, mung bean, urd bean, lentil, fieldpea, lathyrus, cowpea and common bean are cultivated under varied agro-ecological conditions.

Pulses are second most important group of crops after cereals. During the year 2010-2011, the global pulse production was 68 million tonnes from an area of 70.6 million ha, with an average yield of 871 kg ha$^{-1}$ (Anon., 2012). In India, the pulse crops are grown over an area of 24.78 million ha with an annual production of 17.09 million tonnes and average productivity of 694 kg ha$^{-1}$ (Anon., 2013). In Gujarat, during the year 2011-2012, it was cultivated in 8.85 lakh hectares with an annual production of 7.83 lakh tonnes leading to average productivity of 881 kg ha$^{-1}$ (Anon., 2013).

In India, pulses are least preferred by farmers because of high risk and less remunerative than cereals; consequently, the production of the pulses is sufficiently low and doesn’t meet the daily requirement of the growing population. The net capita availability of pulses day$^{-1}$ has been reduced from 61 g in 1951 to 32 g in 2000 (DES, 2004) against the minimum requirement of 60 g and optimum requirement of 104 g per day. Among the different strategies to increase pulse production, the introduction of promising pulse crop such as rajmah (Phaseolus vulgaris L.) to non-traditional areas holds one of the options. Its seed contain 22-25% protein, 11.7% fat and 70% carbohydrates. The green pods contain 1.0-2.4% protein. Rajmah (Phaseolus vulgaris L.) belongs to leguminaceae family have become popular all over the world due to its health benefits as well as their savory texture. It is also known as “red kidney bean”, “common bean”, “navy bean” or “snap bean”. Rajmah is popularly termed as “King of nutrition”.
The genus *Phaseolus* has over 50 species and *rajmah* (*Phaseolus vulgaris* L.) is one of them accounting for 90% of cultivated species world-wide. In India, both bushy and trailing type *rajmah* are found. It is a herbaceous annual plant grown world-wide for its edible dry seed (known as just "beans") or unripe fruit (green beans).

*Rajmah* is an important cool season legume grown for its tender pods, shelled green beans and dry beans. *Rajmah* has various culinary uses. Various healthy dishes can be prepared using this bean in India. Dry seeds have also medicinal value. The foliage of crop may also provide hay, silage, and green manures.

Some of the health benefits of *rajmah* are as follows. *Rajmah* may help in preventing cancer, improve brain function, control blood sugar levels and prevent diabetes. It also help in bone strength/prevent osteoporosis, preventing bad cholesterol (LDL), maintaining healthy skin, preventing irritable bowel syndrome (IBS), weight loss due to its high fibre content.

In western countries, processed pod consumption is quite high. *Rajmah* having 333 k cal. *Rajmah* contain 22.9% protein, 1.3% fat, 66.6% carbohydrates and minerals viz., calcium, phosphorus, iron and vitamin such as vitamin-A and C. Similar to other beans, the french bean is high in starch, protein, and dietary fibre.

It is mostly cultivated in temperate, sub-tropical regions and also in many parts of tropics with temperature around 21°C. *Rajmah* grown on a variety of soils ranging from light sand to heavy clay, but well drained loam soils are the best. The crop is sensitive to salinity. It is highly susceptible to frost. Major *Rajmah* growing countries are Brazil, Mexico, Peru, Canada, USA, Rumania, China, and Kenya. Among them Brazil is top producer of *rajmah* in the world. Globally *rajmah* is cultivated on about 28.0 m ha with a production of 19.0 million tonnes (Anon.2003). In India, important *rajmah* growing states are Jammu and Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Uttar Pradesh, Tamil Nadu, Kerala, Karnataka, Punjab, Bihar and Maharashtra covered an area of 98,000 ha with production of 1000 tones. In Gujarat, there is no statistics about the area and production of this crop. But it is not entirely new crop in our region, it is grown in some parts of Gujarat (Anon. 2013).

*Rajmah* is a high productive and input responsible crop suitable for intensive cropping system. The crop has been successfully introduced in northern plains by developing suitable varieties. Recently *Rajmah* is becoming popular in central zone and two varieties have been released for cultivation in Maharashtra and Gujarat.
Rajmah has a great potential and can contribute substantially to foreign exchange. The major bottleneck is the marketing which needs to be strengthened.

In India, rajmah is grown in *kharif* and *rabi* seasons in different parts. Rajmah has shallow root system and hence moisture stress at any stage is detrimental to its performance. As a rainy season crop, it does not require irrigation, when rainfall distribution is even throughout crop growth.

Rajmah is generally sown at 30 cm apart. In northern plain, *rabi* rajmah is sown in rows of 45 cm along with 10-12 cm plant-to-plant spacing. For obtaining good yield, its plant population should be 2.5-3.0 lakh plants ha$^{-1}$.

Unlike other *rabi* pulses, rajmah is very inefficient in biological nitrogen fixation owing to poor nodulation. It is almost unable to fix atmospheric nitrogen symbiotically, hence responds well to nitrogen application. Due to this, it requires relatively higher doses of nitrogenous fertilizer (100 kg N ha$^{-1}$).

Multi-location studies conducted under AICPIP revealed yield advantage of 1.01 and 1.05 t ha$^{-1}$ with the application of 120 kg N ha$^{-1}$, 60 kg P$_2$O$_5$ over unfertilized NWPZ and NEPZ, respectively. Productivity of rajmah is low in various states due to inadequate use of fertilizers is one of the most important reasons of its low productively.

Among the different factor affecting the yield, spacing and fertilizer play an important role on the yield of rajmah. The yield of rajmah may be increased by sowing rajmah crop with appropriate combination of plant spacing and fertilizer application.

Therefore, the present study was undertaken to identify spacing and fertility levels for rajmah crop during *rabi* season to find out their effect on yield and nutrient uptake with the following objectives:

1. To study the effect of spacing on growth, yield and quality of rajmah.
2. To find out the effect of fertility levels on growth, yield and quality of rajmah.
3. To ascertain the interaction effect of spacing and fertility levels on growth, yield and quality of rajmah.
4. To work out an economically viable spacing and fertility level for rajmah.