CHAPTER-I

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In India, cereals and pulses generally account for about two third of the dietary intake. Pulses have been the mainstay in Indian Agricultural economy. Inclusion of legumes in cropping system has played an important role in productivity of the soil through centuries. The various cropping systems recommended and followed inclusion of grain or fodder legume as a component. The beneficial effect of these crops vary greatly depending upon the type of crop, its duration, fertilizers applied to it and its nodulation pattern etc. The beneficial effect of legume in improving soil fertility mainly occurs through the atmospheric nitrogen fixation.

Rajmash (*Phaseolus vulgaris* L.) known as common bean, frenchbean, dry bean and snap bean, is the native of Central America and nearly 70 species of *Phaseolus* are adapted in American continent. Dry bean has occupied more than 80 per cent of global acreage. There are two major ecotypes of common bean viz. dry bean and snap bean. Snap bean called as frenchbean/garden bean/green bean/strangles bean are cultivated for green pods, while dry beans are harvested at maturity. Snap beans are often large seeded, cream mottled/red mottled/pink mottled/white mottled in colour. Consumer preference depends upon size, colour, shape and brilliance of seeds (Singh, 1992 and Voysset and Dessert, 1991). Dry bean dishes range
from simple beans boiled in water to more sophisticated preparations of baked beans, cakes, chips, cream pastes, salad, soup and stew. Dry, green-shelled and snap bean have high nutritional value and provide a balanced meal when eaten with cereals and other carbohydrate rich foods. Beans can also reduce cholesterol and cancer risk (Anderson et al., 1984).

Common bean, a short day crop (White and Laing, 1989) is grouped as small (<25g/100 seed), medium (25-40g/100 seeds) and large seeded (> 40g/100 seeds). Mildly cool environments with 16°C to 18°C mean temperature and about 7.2 hour day length are favourable for its proper growth and development. High temperatures (30°C day and /or 20°C night) during flowering, especially when relative humidity is low, can severely limit its production. Low temperature (below 10°C) and frost during the growing season can reduce yield up to 100 per cent (Teran and Singh, 2002).

Light loamy soils with pH between 5.5 to 7.0 and rich in organic matter are suitable for common bean production. Practically, a crop of 90 to 120 days with seed yield of 2,500 kg ha⁻¹ usually removes 60-80 kg of nitrogen and 40 kg of phosphorus from soil. In acidic soils, which are deficient in nitrogen and phosphorus and contain toxic level of aluminium and/or manganese, it is essential to use lime and fertilizer rich in nitrogen and phosphorus, as well as other major and minor elements (Thung and Rao, 1999). Similarly, in alkaline soils, deficiency of micro-elements like zinc, iron and boron is common and use of gypsum, sulphur and fertilizers rich in these elements is necessary.
The state of Chhattisgarh is spread over in 13.51 million (m) hectare (ha), of which 4.52 m ha is net cultivable. Chhattisgarh having diverse agro-climatic conditions is divided into three zones viz., Chhattisgarh plains, Bastar plateau and Northern hills of Chhattisgarh. Monocropping of rice in kharif season has become the characteristic of the state and the present cropping intensity is only 117 to 135 per cent. Because of limited resources of irrigation in rabi season, only 25 per cent is under cultivation mostly with utera (relay) cropping of grasspea (Lathyrus sativus L.) and linseed (Linum usitatissimum) having very poor productivity of 1-2 q ha⁻¹. Continuous efforts are being made to increase the productivity of the existing crops as well as to diversify the existing cropping systems. Winter season crops are being mostly grown in Durg, Kabirdham, Raipur and Bilaspur districts as sole crops of chickpea, lentil, pea, mustard, sunflower and safflower.

Attempts are also being made to introduce commercial crops like sugarcane, spices and medicinal plants for improving the economic status of the farmers. Similarly, attempts are also being made to introduce more remunerative crops in rice based cropping system. Among them, inclusion of protein rich crop of rajmash (Phaseolus vulgaris L.) in rabi season after the harvest of rice will not only provide higher return but also fulfil the demand of pulses in the state.

Rajmash is a nutritious pulse containing 21.1 per cent protein, 1.7 per cent fat, 69.9 per cent carbohydrate, 381 mg calcium, 4.25 mg
phosphorus and 12.4 mg iron in 100 g of seeds. Besides, it is free from pest and diseases. High demand of rajmash on account of its recognition as a special dish and high market premium attracts to the progressive farmers. Its cultivation was limited to cooler climate of Jammu & Kashmir and Uttranchal, however, successful introduction of rajmash in Western Uttar Pradesh and Maharastra has now opened avenues of its cultivation in plains. Unlike other pulses, rajmash have fibrous roots and poor nodulation and is inefficient in trapping atmospheric nitrogen for use. Hence, it requires high nitrogen and important micro nutrients like zinc and molybdenum (Singh et al., 2006). It is agronomically input responsive and hence, requires assured irrigation and high doses of nitrogen. Though, its cost of cultivation is comparable to the wheat but its high premium and demand will make the crop more remunerative.

Research attempts are being made to introduce rajmash in Chhattisgarh plains under intensive input management. It is a short duration crop and can successfully be grown after the harvest of early and medium duration rice and thereafter short duration crop like- mung, urd, cowpea can also be taken in summer season under irrigated condition thereby increasing the cropping intensity up to 300 per cent. Beside this, there are good chances of its export as canned seeds and green pods as vegetable. This will definitely increase the economic status of the farming community of the Chhattisgarh.
In Chhattisgarh, rice being the main crop is grown in more than 80 per cent of cropped area. Fields remain fallow after harvest of rice due to lack of sufficient irrigation facilities. Only grasspea and linseed are being cultivated as *utra* in sequence with rice. But, now a days with the increasing potential of irrigation new and remunerative crop like rajmash can be very well fitted in irrigated rice based cropping system. In Chhattisgarh, at present frenchbean is grown and used for vegetable purpose. There is a great potential of dry bean, which is grown for grain purpose and sold in the market as dry seeds. Rajmash has a great potential and can contribute substantially to foreign exchange by exporting canned seeds. The major bottleneck is the marketing, which need to be strengthened. The population in the urban areas is multiplying very fast and in near future marketing facilities are likely to be improved with the development of road facilities. Hence, rajmash cultivation will definitely assume importance under Chhattisgarh condition.

Rajmash is poor in nodulation, so its nitrogen requirement is more than other pulses. Like other nutrients, importance of zinc can not be ignored. Zinc is playing role not only in improving nitrogen use efficiency, but contributes positively in the nodulating leguminous species. The addition of farmyard manure improve the physico-chemical properties of soil and maintain the soil fertility. Therefore, in *Vertisol* of Chhattisgarh, it is necessary to evaluate the optimum levels of nitrogen, zinc and FYM for obtaining good yield of rajmash.
On account of this, it has become essential to work out its nutritional requirement in heavy soils under rice based cropping system in Chhattisgarh plains. Hence, the present study on “Effect of organic and inorganic nutrition on productivity potential, economics and energetic of rajmash (Phaseolus vulgaris L.) under Vertisols of Chhattisgarh plains” was carried out during the year 2004-05 and 2005-06 at the Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the following objectives:

1. To assess the effect of farmyard manure, nitrogen and zinc application on the productivity of rajmash in Vertisols (Shrink-Swell soils) of Chhattisgarh plains,

2. To understand the morphological and physiological traits of rajmash as influenced by farmyard manure, nitrogen and zinc,

3. To determine the effect of farmyard manure, nitrogen and zinc on nutrient uptake and quality of rajmash, and

4. To assess the energetic and economics of rajmash cultivation as influenced by farmyard manure, nitrogen and zinc under the proposed agro-ecological situation of Chhattisgarh plains.