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 include either a component of grain or fodder legume. The beneficial effect of these crops vary greatly depending on 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. Legumes have been reported to fix about 14-35 m t of N per year. India being a sup-tropical country has conducive conditions for the growth of these crops and thus harvests appreciable amount of atmospheric N per year. Most of the grain legumes are giving N advantage of 30-50 kg ha$^{-1}$ to succeeding cereal crops. Apart from it, non-legumes are also benefits by legume in association because of N transfer to the legumes directly through root exudates and indirectly through decomposing roots, leaves, and stubbles (Singh, 1992a).
Urdbean (*Vigna mungo* L. *Hepper*) is an important pulse crop of Indian Agriculture. It is warm weather crop and cultivated in rainy, winter, and summer seasons in various part of the country. It is highly priced pulse crop and rich in phosphoric acid. It is nutritionally rich crop having good source of protein (20-24 %), carbohydrates and fats. It is also a good source of calcium, iron, niacin and has medicinal importance too. Being rich in lysine and poor in methionine, it makes a good complimentary protein diet when mixed with cereals. The total area under pulse crops in our country is 23.19 m ha with the productivity of 623 kg ha\(^{-1}\) and out of this the urdbean occupies an area of 3.15 m ha. The production of this crop is 1.4 m t with the productivity of 473 kg ha\(^{-1}\) (Rathore, 2000). Urdbean is an important crop of Chhattisgarh. It occupies an area of 1.2 lakh ha, with the production and productivity of 0.39 lakh tonnes and 325 kg ha\(^{-1}\), respectively.

Wheat (*Triticum aestivum* L.) is the major food of life for millions all over the world. It is the national staple food of about 43 countries. It is one of the most important food grains and has commanding position in the Agriculture of our country. It contribute about 32 per cent of the total food production in India. The area under wheat is 25.93 m ha and the productivity is 2671 kg ha\(^{-1}\). In India Uttar Pradesh,
Madhya Pradesh, Punjab, Rajasthan, Bihar, Haryana, Maharashtra and Gujarat are the major wheat growing states. Wheat is also important crop of Chhattisgarh and occupies 0.94 lakh ha of land with the production of 0.87 lakh tonnes and per kg productivity is 975 kg ha\(^{-1}\). But total and average yield in Punjab, Haryana, and Uttar Pradesh is more as compared to Chhattisgarh.

Wheat is the major food, principally taken as chapatti, bread, cakes, and other similar products. In addition to supply the food to human beings, it also supplied feed to cattle. The wheat grains have nutritional value of great importance. On an average, it contains 11 to 13 per cent protein. Wheat has a relatively high content of niacin and thiamine. Wheat proteins are of special significance in nutrition. They are principally concerned in providing the characteristic substance “glutin” which is very essential for bakers. Flours of cereals lacking “glutin” are, therefore, not good for breads making. Besides this, wheat is a very good source of carbohydrates (71.2\%). It also contains 1.5 per cent fat, 1.5 per cent mineral matter and 5.3 per cent Fe and Mg. Wheat provides 20 per cent of the total food calories. Wheat bhusa is used as a major part of roughage for Indian cattle.

The nutrient management in individual pulse crops has been attempted for different situation. However, meagre
attempts have been made on nutrient management in cropping system. Studies in the recent past have amply shown that current and residual transfer of fixed nitrogen to cereal component of the cropping systems affected substantial N economy and resulted in higher productivity of cropping system. The fertilizer N constituents are important and costly input in present day agriculture of cereal production particularly in tropical and subtropical parts of the world. Therefore, it is essential to develop well planned cropping system which include legumes to partly meet the N needed for growth and development of cereal component of the cropping system.

The nutrient status of soil in cropping systems is of major practical importance because of the large quantities of nutrients removed by intensive cropping systems. Each crop in the sequence should receive optimum dose of fertilizer particularly when it does not include a legume. However, inclusion of legumes in the cropping sequence results in N economy in the succeeding cereals to produce the same yield levels. Inclusion of legumes in sequence improved N status of the soil, the highest gain in soil N being 81 kg ha⁻¹ in maize-potato-greengram sequence. Application of adequate fertilizer to preceding legume also effect the productivity of succeeding cereal. Studies on multiple cropping sequences conducted at
Varanasi (U.P.) for several years have shown that the cereal following a legume crop yielded substantially higher even if all the crops of the sequence received recommended dose of fertilizers. Studies conducted at IARI, New Delhi on quantification of N economy through *kharif* legumes on succeeding wheat revealed that wheat yield after legumes were invariably higher at all the levels on N as compared with wheat raised after sorghum. Clusterbean, blackgram, pigeonpea and soybean added 75.5 kg, 65.5 kg, 39 kg and 50.5 kg N ha⁻¹ in the soil, whereas, sorghum depleted the soil to the tune of 25.5 kg N ha⁻¹. These legumes affected an economy of N ranging from 33.3-78.5 per cent over sorghum for the production target of 45 q ha⁻¹ of wheat (Singh, 1997). Phosphorus is an important plant nutrient in pulse production. Phosphorus fertilized pulses not only yielded more over unfertilized one but also favourably affected the yield of subsequent cereal crop.

The inclusion of legumes in a cropping system improves the productivity of soil, and the yield of subsequent non-legume gradually increases owing to provision of N and other growth promoting factors such as increased nutrient availability, improved soil structure, reduced disease incidence and increased mycorhizal colonization (George, 1987). Wheat grown after cowpea gave significantly higher
gram yield (4.2 t) followed by wheat after fieldbean and economized fertilizer N to the extent of 40 kg N ha\(^{-1}\). Economic analysis revealed that maximum net return of Rs. 11,550 ha\(^{-1}\) was also obtained with cowpea-wheat sequence. Higher wheat yield after leguminous crops could be attributed to biological fixation on N and addition of root mass by legumes, thereby improving physical and chemical properties of soil. These in turn increased the wheat yield (Sinsiwar, 1994).

Bhatnagar and Chaplot (1996) reported that the urdbean-wheat system with full fertilizer application (20 kg N + 40 kg P + 20 kg K and 120 kg N + 40 kg P + 20 kg K ha\(^{-1}\) for legume and wheat, respectively) gave significantly higher total wheat equivalent yields and net return. Balyan (1997) also reported that the maximum grain yield of wheat was obtained, when it was preceded by legume (clusterbean and cowpea). This might be due to improvement in soil productivity with the addition of more organic matter and N to the soil through legume, which helped in increasing the yield of succeeding crop of wheat. The N uptake in wheat was markedly higher when wheat was followed by legume. Higher yield of wheat was obtained when grown after blackgram compared with that grown after soybean, sorghum and rice (Dwivedi et al., 1998). They also concluded that the productivity of legume based
cropping sequences increases due to effective and economic utilization of residual and cumulative carry-over nutrients and soil moisture. Tripathi et al. (1989) concluded that in cropping systems without legumes there was generally a slight decrease in soil available N status, while available P and K generally increased slightly. When wheat was grown after blackgram, the optimum dose of N was found to be 121.0 kg ha\(^{-1}\) (Kumar et al., 1998). Generally, fertilizer dose is recommended on the basis of individual crop response to direct application of nutrients, without apportioning the weightage to the previous crop and fertilizer applied to them in sequence. Since a limited part of the applied nutrients is utilized by a crop, fertilizer requirement of the succeeding crop may be modified by the residual nutrients (Shivram and Ahlawat, 2000a).

The wheat crop responded significantly to 80 kg N + 40 kg P\(\textsubscript{2}O\textsubscript{5}\) ha\(^{-1}\) (Gill et al., 1994). The response of wheat grain yield and yield components to N was significant up to 90 kg ha\(^{-1}\) at Ambikapur (Mishra et al., 1994). Singh et al. (1995) reported that the wheat grain yield increases up to 120 kg N ha\(^{-1}\), whereas, significant increase in grain yield was obtained only up to 80 kg N ha\(^{-1}\). Phosphorus application increased the grain yield significantly upto 40 kg P\(\textsubscript{2}O\textsubscript{5}\) ha\(^{-1}\). Mathan et al. (1996) reported that application of 25 kg N ha\(^{-1}\) + 50 kg P ha\(^{-1}\) as enriched farmyard manure in 750 kg ha\(^{-1}\) + 6.25 tons ha\(^{-1}\)
FYM as basal with *Rhizobium* inoculation was found optimum and recorded 75.0 and 54.5 per cent more seed yield than the control in the first and second crops, respectively. The grain yield, straw yield and protein content of wheat were increased significantly with the increase in levels of NPK from 30:15:0 to 120:60:60 kg NPK ha\(^{-1}\). Significant improvement due to increased levels of NPK was also noticed for uptake of nutrients (Auti *et al.*, 1999). Highest average seed yields of urdbean of 882 kg ha\(^{-1}\) was found with 20:40:20 kg NPK ha\(^{-1}\) followed by 649 kg with 20:40 kg NP ha\(^{-1}\) compared with 414 kg without NPK (Singh *et al.*, 1989). The application of 10 kg N, 40 kg P\(_2\)O\(_5\) and 20 kg K\(_2\)O ha\(^{-1}\) with *Rhizobium* had no significant effect on seed yield of *Vigna mungo* following potatoes grown with high NPK rates (Gupta, 1989).

In Chhattisgarh, the average annual rainfall is 1400-1600 mm, which is mainly congenial for rice cultivation. As regards to soil type, rice is mainly cultivated in Matasi (Inceptisols), Dorsa (Alfisols) and Kanhar (Vertisols), which represents 45.5%, 10% and 25% of total net cultivated area, respectively. In Chhattisgarh, the upland unbunded bharri (Kanhar) occupies 10% (3.4 lakhs ha) area. This situation is most favourable for cultivation of pulses in *kharif* season. With the availability of limited irrigation, prolonged winter season and photo-insensitive varieties, wheat is widely
cultivated during rabi season by the farmers of the Chhattisgarh. At present, kharif urdbean is planted under flat system where, the plant population very oftenly reduces due to accumulation of water in the field. Different method of planting tested under this experimentation will be helpful in determining the optimum method of planting for obtaining good crop stand of urdbean. Among the various inputs, the fertilizer play a crucial role in crop productivity. Since, this is a costly input, it's balanced and judicious use in the individual crop and cropping system needs thorough evaluation in a particular agro-ecological situation. Wheat is an exhaustive crop and requires heavy fertilization. Therefore, the planting of wheat in succession to kharif urdbean with optimum and reduced level of nutrients will be helpful in nutrient saving without adversely affecting the productivity potential of urdbean-wheat cropping system.

The work on planting methods and nutrient management in kharif urdbean and its residual effect on succeeding wheat is very meagre in Vertisols of Chhattisgarh plains. There is lot of scope to exploit the potential of bharri (Vertisols) land. Keeping in view the above facts, the present research work entitled “Studies on planting method and nutritional management in kharif urdbean (Vigna mungo L. Hepper) and their effect on productivity potential of
succeeding wheat (*Triticum aestivum* L.) in *Vertisols* of Chhattisgarh plains" was carried out during the year 2002-03 and 2003-04 at the Instructional Farm, Indira Gandhi Agricultural University, Raipur with the following objectives:

1. To identify the suitable planting method for harvesting higher productivity of *kharif* urdbean in *Vertisols*,

2. To determine the optimum nutritional requirement for *kharif* urdbean,

3. To evaluate the residual effect of *kharif* urdbean on wheat at optimal and sub-optimal level of nutrition, and

4. To work out the economics of urdbean-wheat cropping system under various approaches of planting methods and nutritional management.