CHAPTER-1:

INTRODUCTION
Introduction

Food legumes are second most important group of crops after cereals, and legumes are considered to be the most valuable plant source for human and animal nutrition. They have a special significance in subsistence farming and nutritional security of resource poor masses in developing countries. They are an excellent source of high quality protein. The protein content of legumes is higher than as compared to any other vegetable product and animal flesh. Legumes have been cultivated and used for centuries all over the world. The importance of legumes in cropping pattern has been stressed by many scientist and researchers. Legumes are excellent fertilizers and greatly increase the nitrogen content of the soil. They play an important role in improving soil health, long term fertility and sustainability of the cropping systems. Legumes predominantly grow under poor resources and are frequently prone to drought, biotic and biotic stresses.

Legumes are one of the important sources of protein, carbohydrate, dietary fiber and minerals (Tharanathanand and Mahadevamma, 2003). They are are notable for their ability to fix atmospheric nitrogen by symbiotic relationship with bacteria “Rhizobia” found in root nodules of these plants. This ability of mutualism reduced fertilizer costs for farmers and gardeners who use legumes and allow them to be used in a crop rotation to replenish soil. Legumes also provide essential minerals required by human beings (Grusak, 2002a) and produce health promoting secondary compounds that cannot only protect against human cancer (Grusak, 2002b; Madar and Stark, 2002) but also protect the plants against the onslaught of pathogens and pests (Dixon et al. 2002; Ndakidemi and Dakora, 2003). In addition to their blood cholesterol reducing effect (Andersen et al. 1984), grain legumes generally also have a hypoglycemic effect reducing the increase in blood after a meal and hence, blood insulin. Legumes are therefore included in the diet of insulin-dependent diabetic patients (Jenkins et al. 2003). Beans are an excellent source of protein, vitamins and minerals particularly calcium, phosphorus and iron and thus are highly nutritious (Saulunkhe and Kadam, 1998). Legumes have been used for various medicinal purposes in Ayurvedic and Unani system of medicine useful in piles, asthma, paralysis, leucoderma, gonorrhoea and infection of the nervous system, liver and cough.
Pulse crops or grain legumes are the major source of protein in the predominantly vegetarian diet of the people of India. India probably grows a greater variety of pulse than any other country (Nene, 1986). These pulses include chickpea (*Cicer arietinum* L.) pigeon pea (*Cajanus cajan* Mil sp.), black gram (*Vigna mungo* L.), green gram (*Vigna radiata* L.) Wilczek), lentil (*Lens culinaris* Medik), pea (*Pisum sativum*), moth bean (*Vigna aconitifolia* (jacq.) Marechal), Khesari (grass pea) (*Lathyrus sativus* L.) and cowpea (*Vigna unguiculata* L. Walp.)

The climate of Chhattisgarh is mainly tropical humid and sub-humid. Legume crops are cultivated in kharif, rabi and zaid seasons. Kharif crops require warm climate throughout their sowing to harvesting. Rabi crops require mild cold climate during sowing period and during vegetative to pod developments. In India required temperature for the growth of pulses is 20-30ºC and rainfall 50-75 cm.

The newly formed Chhattisgarh state with an area of 1,35,192 km² came into existence on 1st November 2000. It lies between 17-46º to 24-5º North and 80-15º to East. The climatic condition during summer is hot and dry wind blows over the state. During summer season, the temperature varies from 25-42ºC. Agriculture is the main occupation of the people of Chhattisgarh where nearly 80% of the population is engaged in cultivation. The major crop grown in Chhattisgarh is paddy especially in central plain of the states and is popularly known as rice bowl of India. Apart from paddy other crops grown here are oilseeds, wheat, ground nut, maize and pulses.

In this piece of research work, 10 legume crops have been selected for phytopathological studies, 5 each from Kharif and Rabi crops.

**Kharif crops:** viz.

1. *Cajanus cajan* L. (Arhar)
2. *Dolichos lab-lab* L. (Sem)
3. *Glycinemax* L. (Soyabean)
4. *Vigna radiata* L. (Mung)
5. *Vigna mungo* L. (Urid)

**Rabi crops:** viz.

1. *Lathyrus sativus* L. (Teora)
2. *Pisum sativum* L. (Matar)
3. *Pisum arvense* L. (Chhota batra)
4. *Lens culinaris* L. (Massoor)
5. *Trigonella foenum-graecum* L. (Methi)

- *Cajanus cajan* L. is an important food legume rich in starch, protein, calcium, manganese, crude fiber, fat, trace elements and minerals (Saxena, 2010).
- *Dolichos lab-lab* L. is an important food source in tropical Asia and Africa and source of protein for both human and livestock. It is used as antidiabetic, analgesic, antioxidant, cytotoxic, antimicrobial effect and can also be used for treatments of iron deficiency anemia.
- *Glycinemax* L. is included in human diet in many Eastern countries, due to its high nutritive value including high quality protein, significant content of minerals and fibers, small amount of saturated fat and absence of cholesterol (Silva et al. 2006).
- *Vigna radiata* L. is rich in terms of essential oil, high fiber, content, protein, minerals, such as phosphorus, calcium and vitamins. (Wiryawan, et al. 1995).
- *Vigna mungo* L. is a good source of carbohydrate, minerals and richest source of protein and vitamin B, potassium, calcium, magnesium, and iron. It is summer and kharif pulse crop with high nutritive value (Karamany, 2006).
- *Pisum sativum* L. and *Pisum arvense* L. Peas are important annual legume crops and consumed extensively by both human and animal feed. Both seeds and forage of pea are rich in protein and mineral contents (Acikgot et al. 1997)
- *Lens culinaris* L. is tolerant to drought and grown throughout the world, they are good source of potassium, calcium, zinc, niacin and vitamin k but are particularly rich in dietary fibers, protein, folate and iron.
- *Trigonella foenum-graecum* L. is a good source of medicine having high nutritional value. (Jani et al. 2009). It is also used for hypoglycemic activity.

Macronutrients play a very important role in plant growth and development. Their function ranges from being structural units to redox-sensitive agents. Micronutrients play a vital role in growth and development of plant and increasing crop
yields. Infact, their essential role in plant nutrition and increasing soil productivity makes their importance ever greater (Dewal and Pareek, 2004).

- Nitrogen – is one of the imperative elements for proper growth and development of plants which significantly enhances yield and its quality by playing a vital role in biochemical and physiological function of plants. The most important nutrient limiting the growth of plant is nitrogen (Postagate, 1982).

- Potassium plays an essential role in enzyme activation, protein synthesis, photosynthesis, osmoregulation, stomata movements, energy transfer, phloem transport, anionic balance and stress resistance. (Marschner, 2012)

- Phosphorus (P) is essential for all living organisms. Plant must have phosphorus for normal growth and maturity. Phosphorus plays a role in photosynthesis, respiration, energy storage and transfer, cell division, and several other processes in plants. The stunted growth induced by phosphorus deficiency has been correlated with smaller leaf size and lessened number of leaves. (Zambrosi, 2014).

- Iron is a constituent of several enzymes, and some pigments assists in nitrate and sulfate reduction and energy production within the plants. Although iron is not used in the synthesis of chlorophyll, it is essential for its formation and also essential for human body for the production of haemoglobin in oxygenation of red blood cells. (Seetharami et al. 2013).

- Zinc is essential to all organisms. It is an important trace element playing a definite role in the metabolism growth and development. (Singh et al. 1997).

- Copper is an essential constituent of several enzymes, it is involved in many plant metabolic reactions. It is required for maintaining a healthy heart, blood vessels for the synthesis of developments of bones and nervous system. (Seetharami et al. 2013).

- Manganese plays an important role in various biological systems including photosynthesis, respiration and nitrogen assimilation. It is an antioxidant and essential for the breakdown of fats and cholesterol and also help in the nourishment of the nerves and brain. (Chaturvedi et al. 2004).
The science of plant pathology or phytopathology deals with the disease of plants and scope of this subject lies in the realization of the extent of losses caused by diseases and application of systematic knowledge to eliminate or minimize these losses. As Horsfall and Dimond (1959) have summarized “when something is functioning poorly” in the body we come to the decision that we are sick hence “disease malfunctioning process is caused by continuous irritation. This process result in suffering therefore, disease can be defined as a pathological process. Plant diseases have been studied because they damage cultivated crops, but it is paradoxical that even today there are few reliable estimates of loss (James, 1974). Disease is a major important limiting factor which causes great annual losses and sometime complete crop failures (Hanonik and Bisri 1991).

Fungi are the most important group of pathogens which reduce the crop yields. Species of Alternaria, Fusarium, Trichothecium and Cladosporium were associated with poor emergence of soybean in north western hill of Uttar Pradesh have been reported by (Sharma, 1987). The incidence and distribution of Phytophthora blight of pigeonpea in different agro climatic zones of Uttar Pradesh have been reported by Mishra and Shukla, 1987. The age of soyabean plant at the time of inoculation significantly influenced the development of Myrothecium leaf spot disease was studied by Shrivasatava and Khan 1993. The leaf blight disease of groundnut caused by Alternaria alternata (Fr.) Keissler, was reported by Balasubramanian (1979), Subrahmanyam et al. (1981), Vyas et al. (1985) and Narain et al. (1987). Leaf spots like Cercospora leaf spot, Anthracnose and Alternaria leaf spots are the major phytopathological constraints in sustainable cultivation of blackgram in Rajasthan (Amit Trivedi et al. 2014). The characteristic leaf blight symptom of disease observed was quite different from the first report of the disease caused by Alternaria alternata (Balasubramanian, 1979). Alternaria alternata required relative humidity of 85% and above (Reis et al. 2006) and optimum temperature range 25-30°C for conidial production. Wilt caused by Fusarium udum is the most important disease of pigeonpea in India causing heavy production losses and is a major hurdle in realizing full yield potential of this pulse crop (Kannaiyan et al. 1984; Reddyetal. 1998; Vishwa Dhar et al. 2005).

Leaf spot and pod blight of uridbean (Vigna mungo) caused by Cercospora canescens, Cercospora cruenta, Colletotrichum dematium (f. sp. truncatum) and
Ascochyta phaseolorum are of common occurrence in Himachal Pradesh. (Sood et al. (1981) Bhardwaj and Singh, (1986); Singh et al. (1979). Powdery mildew of mung and urid caused by Erysiphe polygoni is a very serious disease in Madhya Pradesh (Khosla et al. 1988). Disease is a major constraints in economic crop production as they inflict heavy losses. Several pathogens are reported to be pathogenic on this crop. Aerial blight caused by Rhizoctonia solani Kunn, is one of the most serious soil-borne disease of soyabean particularly in the northern zone comprising the states of Haryana, Punjab, Uttar Pradesh and Uttarakhand. (Anjana ray et al. 2007). Yield losses can exceed 35-60 per cent and and the disease is considered as economically important (Patel and Bhargava 1998, Fenille et al. 2000).

Colletotrichum is one of the most important plant pathogen world-wide, causing anthracnose diseases in a wide range of hosts including cereals, legumes, vegetables perennial crops and fruits (Baily and Geger 1992).

Pathogenicity is an ability of pathogens to cause disease and can be considered an attribute of particular individual agent or as characteristics of a group of agents. The host pathogen interaction has been well conceived and defined under the term pathogenesis. The pathogenesis is a complete phenomenon which involves abilities of the host and pathogen that determine occurrence of disease or no disease. Mbadianya et al. 2013 studied that pathogenicity test of fungi collected from the leaf spot disease of egg plants. Pathogenicity of four Fusarium spp has been studied. on Acacia koa seedlings (Dudley et al. 2007).

Cultural, morphological and pathogenic variability could be preliminary parameters for characterizing the fungal isolates. Krishna kumar et al. 2011 have studied cultural characteristics of Colletotrichum gloeosporioides. Morphological and pathogenic variations are known in many fungal pathogens (Koech et al. 1994; Kumar et al. 1995).

Carbohydrates are the most abundant class of organic compounds in the animal and plant world. Analysis of sugars has considerable importance to the food and beverage industries (Peris, 1996). Carbohydrates can also be used used for starting material for the biological synthesis of other types of compounds in the body, such as fatty acids and
certain amino acids. Sugar utilization efficiency is variable in different organisms (Karkashe, 1984; Rawte, 2011).

Protein is an important nitrogenous macromolecule composed of amino acids linked together by peptide linkages. It is the most important and major cell constituents of all microbes, bacteria and plants. They derive their nitrogen requirements directly or indirectly from plants and microbes proteins. The total content of protein (of plant and pathogens) usually increases during the early stages of infection (Uritani, 1977). Amino acid, organic acid and sugars production capacity is variable in different organisms (Rawte, 2011; Kohli, 2003).

Enzymes are thermolabile substances which catalyse many of the biochemical processes of living organisms and thus play a fundamental role in host-pathogen interaction. Cellulase is the most abundant organic compound on earth and has received much attention as a substrate for the production of biofuels, single cell proteins and various other chemicals through enzymatic degradation by microbial cellulases. Cellulase is the principal enzyme of the cellulytic moiety which represents a complex of enzymes that degradative cellulose, in several stages to the constituent’s glucose residues. Cellulases are produced by the pathogens for the degradation of cell-wall and the cellulose micrifibrils. Cellulase enzymes complex consists of three major enzymes components which are endo- -(1-4)-D-glucanase, exo- -(1-4)-Dglucanase and -glucosidase that work synergically in complex cellulose degradation (Saha 2004 and Kim et al. 2008). The role of pectinmethylesterase (PME) in pathogenesis was related with degradation of the plant cell-wall pectin acids though purified pectinmethylesterase (PME) preparation have not been found to causes tissue maceration and cell death. Ali (1977) has recorded that Botryodiplodia theobromae produced pectinmethylesterase (PME) during pathogenesis which was synergistically associated with its polygalacturonase (PG). Polymethylgalacturonase (PMG) a chain splitting enzyme catalyses hydrolysis of pectin and pectinic acid present in plant cell walls. During various incubation periods, the in-vivo and in-vitro production of polygalacturonase (PG), polymethylacturonase (PMG) and cellulose (Cx) enzymes have been studied in Alternaria solani by Chaurasia et al. (2014.)
Several fungi have been found to produce acid and alkaline phosphatases which are involved in the energy metabolism of organisms (Arora et al. 1983; Rawte, 2011).

To reduce the loss due to plant diseases; antibiotics, fungicides, and angiospermic sources were found effective and economic. Mostly three types of control agents are used for disease protection (Shrivastava, 2012).

Antibiotics have become popular as plant protection chemicals. These are used mostly as spray materials at very low concentrations and have certain degree of systematic action. They normaly get absorbed and translocated by the plant system. However, use of antibiotics requires certain precautions as very often they are phytotoxic and may kill the plant tissues. Effect of griscoulvin has been studied and showed inhibitory effect against the fungi with chitinous cell wall (Brain, 1949). Teramycin and neomycin (Sharma, 2011), Norfloxacin (Rawte, 2011) have been reported effective antibiotics for disease control.

Fungicides are chemicals which when applied to the plant get into the system of the plant and persist in the protoplasm toward infection by parasites. They potentially appear to be effective and economical substances for artificial immunization of the plant against disease. Mancojeb, antracol, blitox are the effective fungicides for the control of Alternaria tageti (Singh et al., 2006). Carbendazim + Mancojeb (Singh et al. 2002), blitox (Rawte, 2011), Bavistin, rovral and topsin-M (Kohli, 2003) have been reported to be the effective fungicides for the control of fungal pathogens. Effect of different fungicides on Colletotrichum truncatum was also studied (Jagtap et al, 2013).

Natural plant products and their analogue have been found as important sources of agricultural bio-pesticides which serve with antimicrobial properties of plant extract (Cardelina, 1995and Okigbo, 2009). Antifungal effect of aqueous and ethanolic solutions of various concentrations of Aegle marmelos leaf extracts have been studied (Raut et al. 2013). Bajpai and kang (2012) have studied in-vitro and in-vivo antifungal activities on leaves and flower of Magnolia liliflora against plant pathogenic fungi. Tijjani et al. (2014) studied the antifungal effect of some plant extracts at different concentrations to control tomato fruit rot in-vitro and in-vivo approaches. Leaves of Zyzphyus jujuba L. also exhibited the antifungal properties against Pyricularia grisea (Kamalakannan et al. 2001).
Leaf extract of *Psidium guajava* L. was tested against fungal pathogens (Panday and shweta, 2011).

**Objective**

- Survey and selection of leguminous crops based on their nutritional quality and medicinal uses by local people.
- The selected crop plants will be collected from different locations of Raipur district during different crop seasons.
- Morphological characterization of disease symptoms will be done.
- The record of the disease symptoms, disease severity and degree of infection caused by the fungal pathogens on the selected crop host will be made.
- To prove pathogenicity test by Koch’s postulates.
- The fungal pathogens will be isolated using standard techniques and their pure culture will be maintained for further studies.
- Determination of the nutritional content of selected host crops in term of Nitrogen (N), Phosphorus(P) Potassium (K), and micro elements (Trace) Iron (Fe), Zinc(Zn), Copper(Cu), and Manganese(Mn).
- Analysis of the cultural characteristics of the isolated pathogens.
- To evaluate sugar utilization capacity, total protein, amino acids, organic acids and sugar of the isolated pathogens.
- Enzymological studies elaborating the
  (I). Extracellular enzymes cellulase (Cx), pectinase poly methylgalacturonase (PMG) and pectin methyl esterase (PME).
  (II). Intracellular enzymes acid and alkaline phosphatases.
- Disease protection with the help of antibiotics, fungicides and angiospermic sources so to get healthy and disease free crops of legumes in Chhattisgarh.