INTRODUCTION
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Legumes constitute an important group of plants which stand next in importance to the cereals. Grain legumes occupy a unique position in world agriculture by virtue of their high protein content and capacity to fix atmospheric nitrogen. In developing countries especially, cultivation of legumes is the best and quickest way to augment the production of food proteins. In our country with a predominantly vegetarian population, pulses play an important role in meeting the requirement of dietary proteins. They contain 20-30% proteins in their seed, which is 2-3 times more than in the cereals. The proteins from pulses are also nutritionally valuable because of higher lysine content than the cereal proteins. These two groups of crops have a complementary relationship in their amino acid composition and their combined intake can compensate to a great extent for their mutual amino acid deficiency. Pulse crops have also assumed importance in view of their relatively low water requirement for cultivation. Due to such a feature they have comprised important means of increasing agricultural production and farmer’s income in India’s dry lands, which constitute more than 75% of the total cropped area of the country.

Among the pulse crops, lentil (Lens culinaris Medic) commonly known as ‘Masur’ in India, is one of man’s oldest food crops and ranks fifth in world production of pulses (FAO, 1981, 1989). The crop is important in dry land systems as it can offer farmers an alternative to cereal grains and by fixing nitrogen in symbiosis with Rhizobium, can help contribute to the nitrogen budget of infertile soil.
NUTRITIONAL SIGNIFICANCE:

Lentil is a nutritious food legume which has a relatively higher content of proteins, carbohydrates and calories as compared to other legumes and is the most desired crop because of its high average protein content and fast cooking characteristic in many lentil producing regions (Muehlbauer et al., 1985).

Among the cool season legume crops, lentil is richest in important amino acids like lysine, arginine, leucine and sulphur containing amino acids (Williams et al., 1994), besides comprising a good source of vitamin B.

Lentil is mostly used as a main dish, side dish or in salads. Seeds can be fried and seasoned for consumption; flour is used to make soups, stews, and purees and mixed with cereals to make bread and cakes; and as a food for infants (Williams and Singh, 1988). Husks, dried leaves, stems, fruit walls and bran (residues), can be fed to livestock (Muehlbauer et al., 1985).

Green plants of lentil make valuable green manure. Seeds are a source of commercial starch for textile and printing industries (Kay, 1979). In India, lentils are poulticed and applied onto the ulcers that follow smallpox and other slow-healing sores (Duke, 1981) and used as antiaphrodisiac in the diet in monasteries on meatless days (Van der Maesen, 1972).

Antinutritional components in lentil:

Eventhough lentils are considered to be highly nutritious, they contain certain antinutritional factors, such as protease inhibitors, hemagglutinins/lectins, polyphenols, flatulence causing sugars, saponins, phytic acid and tanins.
Protease inhibitors:

The protease inhibitors (PI) are polypeptides or proteins capable of inhibiting the activity of specific proteolytic enzymes. They have been studied in detail due to their possible deleterious dietary effects on animals, as they reduce the quality of food.

Protease inhibitors are widely distributed in plant proteins like in seeds, tubers, leaves, flowers, stems, roots and pods (Honovar and Sohonie 1955, Brik and Waldman 1965). Most of the plant protease inhibitors (PIs) are specific serine proteases (trypsin, chymotrypsin, etc), although inhibitors of sulphydral, aspartyl and metallocarboxypeptidases are also found. Protease inhibitors are not present in protein bodies but are located in cytoplasm.

Trypsin inhibitor was first reported by Read and Haas (1938). Later on, Bowman (1944; 1946) purified it and Kunitz (1945; 1946) isolated it in crystalline form. Molecular weights of plant protease inhibitors range from 4 - 60 kDa. Plant protease inhibitors are quite stable molecules and are often resistant to heat, pH extremes and proteolysis by proteases, (Kasell and Williams 1977, Richardson 1977 and Ryan 1981). Inhibitors of trypsin and chymotrypsin have been implicated in reducing protein digestibility and in pancreatic hypertrophy (Liener 1976).

Significance of protease inhibitors in plants:

Plant protease inhibitors have been considered as useful tool for developing pest and pathogen resistance (Ryan 1990). They prevent uncontrolled hydrolysis of protein and starch within cells, organelles or fluids where regulation of protein and starch hydrolysis is important for biochemical and physiological processes, (Garcia-Olmedo et al., 1987).
Lectins:

Lectins are a group of proteins present in living organisms, which have the ability to bind specifically and reversibly with carbohydrate residues. This property of lectins enables them to bind polysaccharides, glycoproteins and glycopeptides. This binding involves non-covalent interaction such as H-bonds, Van-der-wals forces and hydrophobic interactions.

Stillmark (1888) discovered lectins while studying the toxic effect of castor bean where extracts of castor beans agglutinated erythrocytes. Boyd and Reguera (1949) and Boyd and Shapleigh (1954;1954) coined the term lectins (from the Latin ‘legere’ to select or pick out). Based on their observation that some seed extracts could distinguish among human blood groups. Phytoagglutination or phytohemagglutinin comprises the term used for plant lectins in general. All lectins consist of subunits, the numbers of subunits in plant lectins being two or four. There is one sugar-binding site per subunit of lectin. The wheat germ agglutinins have two such sites per subunit (Nagata and Burger, 1974) while soybean agglutinin, peanut agglutinin, pea lectin and lentil lectin have two binding sites per four subunits (Lotan et al, 1974).

Lectins are widely distributed in nature, they are predominantly present in plants but are also found in animals, viruses and microorganisms. Lectins are of common occurrence in plants especially in leguminosae (Tom and Western, 1971). The richest sources of lectins in most of the plants are the seeds (Summer and Howell, 1936). Lectin exerts a variety of effects on cell, the most extensively studied being agglutination and mitogenic stimulation (Becht et al 1972, and Okada and Kim 1972). It also includes effects like modification of the activity of membrane enzymes, blocking of fertilization of ova by spermatozoa and inhibition of fungal growth (Howard et al.1977).
The fact that lectins are found in legumes such as beans and peas, which are an important source of dietary proteins, raised the question of their nutritional significance (Jaffe 1969; Liener 1974, 1976). It has been proposed that the toxic effects of lectins when ingested orally may be due to their ability to bind to specific receptor sites on the surface of the intestinal epithelial cells (Jaffe 1969). Oliver et al. (1989) and Puszati (1991) reported that lectins have the ability to bind to cellular surfaces and carry relatively high binding affinity to small intestinal epithelium. Lectin produces structural changes in the intestinal epithelium, resulting in the impairment of brush border continuity and ulceration of villi (Oliver et al. 1989 and Puszati et al. 1990), leading to increase in endogenous nitrogen loss (Oliver and Sgarbierry 1986; Schulze et al 1995) and depressed growth rate in young animals. The growth depression effect of lectins is believed to be primarily due to their damaging impact on intestinal enterocytes (Puszati et al. 1979; Lorensonn and Olsen 1982).

Significance of Lectins in plants:

It appears that lectins may protect plants against bacterial, fungal and viral pathogens during the seed imbibition, germination and early growth of seedlings, as lectins are present at the potential sites of invasion by infection agents, (Stillmark 1888, Janzen et al. 1976 and Chrispeels 1984) . In these cases, the plant lectin is transported from the seeds to the roots and then secreted into the soil. Mierlman et al. (1975) suggested that lectin inhibits synthesis of chitin, hyphal growth and spore germination in fungi. Jones et al (1967) and Howard et al. (1972) suggested that the accumulation and the disappearance of lectins in legume seeds may function in seed maturation, germination or in maintenance of seed dormancy.
Mitogenic property of lectins can be used to understand the process of antigen induced immune response in vivo. During mitosis there is increase in size of chromosomes and hence lectins can be used to study the chromosomes by inducing mitosis.

**Polyphenols:**

Polyphenolic compounds are found in a variety of plants utilized as food and feed. Condensed tannins were reported to occur in some grain seeds that are important as humans’ food or animal feed (Ma Yu and Bliss 1978). Polyphenolic compounds are considered to be nutritionally undesirable. They form complexes with proteins, starch and digestive enzymes to cause a reduction in the nutritional value of food (Bressani and Elias 1980). Polyphenolic compounds were reported to be responsible for decrease in growth rate, feed intake, feed efficiency, net metabolizable energy and protein digestibility (Hulse, 1980; Price and Butler 1980; Salunkhe et al. 1982 and Deshpande et al 1984). Polyphenolic compounds in poultry feed cause depressed growth and egg production (Ringrose and Morgan 1970 and Deshpande et al. 1984). Sorghum tannins have been reported to cause leg abnormality in hens and delaying of physical and sexual maturity or even death in hamsters (Butler et al. 1986).

**Importance of Mutation Breeding:**

In common with other plant breeders, the legume breeder’s prime objective has been the development of genotypes capable of producing optimal crop yield of a satisfactory quality in suitable areas of production.

Improvement in either single or few polygenically controlled economic traits and quality attributes, is normally not achieved by hybridization within shortest possible time. Alternatively it has been thought that the targeted recombinants without disturbing the yield/quality status of the existing well adapted varieties is achievable within shortest period of
time by induced mutations. The improvement and production of high yielding varieties has been considered desirable for varied agroclimatic regions of our country. The selection value of the mutant gene has comprised an important criterion in evolving high yielding varieties through mutation breeding.

The potentialities of mutation breeding have been already demonstrated by several researchers for improving the productivity and quality of legumes like chickpea (Kharkwal 1998, 2000), pigeonpea (Dwivedi et al. 1989, Pawar et al. 1982 and Veerswamy et al. 1975), Mung bean (Tickoo and Chandra 1999 and Naik et al. 2000), Urdbean (Singh et al. 2000), Winged bean (Kothekar et al. 1996), Lentil (Sharma 1986 and Solanki and Sharma 1999) and Grasspea (Nerkar 1970 and Waghmare and Mehra 2000).

The improvement aspects like quality and quantity of oil and protein have been successfully attained by several researchers through mutation breeding in oil crops like Soybean (Rawlings et al. 1958, Koo 1972 and Bale 1999), Groundnut (Gregory 1956), Mustard (Zareen 1991) and Safflower (Reddy 1991).

The mutation breeders have visualized that the desirable mutants in different legumes and oil crops would be able to contribute effectively towards yield and protein content besides providing induced variation for disease, insect and pest resistance. India occupies a leading position as regards the production of mutant varieties and is a recognized centre of mutation research on cultivated plants. A large number of mutants have been produced so far in pulses besides cereals and oil seed crops. Up to 1995, 150 mutant varieties belonging to 36 crops species have been released or approved for cultivation (Kharkwal 1996).

Recombination breeding in lentil is tedious. Emasculation and pollination are difficult due to the tiny and delicate structure of flowers, preventing thereby the rapid and successful
hybridization in lentil. Mutation breeding is another approach for improvement in this crop. Induced mutation can be used with advantage over conventional breeding to rectify simple, specific undesirable traits in otherwise well adapted varieties without grossly disturbing their genetic constitution (Gregory 1955, Brock 1967 and Scossirol 1968).

It is visualized that through appropriate genetic manipulation (like mutation breeding), the development of antimetabolite free lentil genotypes with better yield potential can become possible. Keeping this end in view, the modern cytogenetic approach of mutation breeding has been considered worth utilizing in the present study for obtaining the genotypes of lentil carrying reduced level of antinutrients.

The following are some of the major aspects studied during the course of the present investigations.

1. Mutagenic treatments for induction of variability,

2. Effects of different mutagens on M1 parameters such as seed germination, seedling injury, leaf morphological changes, chlorophyll deficient sectors, pollen sterility and survival of plants at maturity,

3. Raising of M2 and M3 generations and their screening for recording variability in regard to various quantitative characters,

4. Selection of useful macromutants having desirable characters such as early maturity and high yielding potential,

5. Analysis of mutants for understanding the status of some antinutritional components,

6. Effects of heat and germination on some antinutritional components,

And
7. The evaluation of lentil germplasm in regard to some antinutritional components.

It is planned to review the results of pertinent investigations carried out previously as well as to highlight the important observations made in the present study in the succeeding chapters.