CHAPTER-IV | SUMMARY AND CONCLUSION

Legume plants in developing countries represent a very important source of protein because animal protein is generally beyond the financial means. Among the plants which provide cheap sources of good quality protein are the pulses. C.cajan is important grain legume of the tropics but there is very little information on physiological changes during pod development of this crop. In India, pulses are grown extensively for several reasons. Firstly, they are adapted to increase fertility of soils and they can grow in both the climatic conditions, i.e., during Kharif and Rabi seasons. Secondly, they have deep penetrating root system which holds moisture more efficiently than any other crop. P.tetragonolobus is grown in tropical area, having high protein content which is nearly three times greater than the protein content of cereals.

C.cajan is widely distributed in the tropics and cultivated extensively for its edible seeds. It is a perennial shrub native of Africa and now grown in Africa, America, America, Australia, Hawai, East and West Indies and India (Anonymous, 1950).

P.tetragonolobus is identified in the humid tropics of South and South-East Asia. In Shrilanka it grows in wet as well as dry zone regions. In India it is grown in states of Goa, Maharashtra, Karnataka, Tamilnadu, Kerala, Madhya Pradesh, Orisa, Bengal and Tripura (Rajendran et al., 1978).

Morphologically C.cajan shows different plant features, roots are long, deeply penetrated with many nodules on it. Stem is angular, hairy and branched, leaves being pinnately trifoliate, with lanceolate/elliptical leaflets, green in colour. Flowers are pale yellow to orange in colour with red or purple spots on petals. Short axillary or terminal racemes are seen.

Pods of pigeonpea are flattened, dehiscent, 4-10 cm in length, 6-12 mm in breadth, green, purple or maroon in colour or green with maroon sploched. Pods contain 2 to 8 seeds, which vary in size, shape and colour.

Root system of P.tetragonolobus shows tap root with nodules on it. Leaves are alternate, trifoliate, long petiole and broadly ovate. Flowers show Racemose inflorescence, axillary peduncles. Flower show two coloured petals, backside petals are pale green, the inner side petal is pale blue, violate and less often white (Backer and Buah, 1963). Pods are four-cornered, rectangular with fringed wings, vary in length, 16 to 36 cm in length with 5-20 seeds in pod. Seeds are shiny cream coloured, greenish brown, deep purple, black or molted.

C.cajan is grown in wide range of soil. Lime soil is good for plant growth. P.tetragonolobus grows better in sandy soils. C.cajan and P.tetragonolobus seeds are rich in protein, vitamin, mineral and calories. Green, tender pods of C.cajan constitute a very favourite vegetable in some parts and eaten as dal. The stalks are utilized for various purposes such as roofing, walling sides of carts and basket making Tubers of P.tetragonolobus are boiled, steamed, baked, fried, roasted and eaten. It has high content and each part is used for medicinal and nutritional purposes. Young pods can be preserved by processing into a pickle in Tamil Nadu and South India. Carbohydrate contents in both these legumes are less but protein contents are more. High calcium contents are seen in these legumes.

The process of pod development is very important phenomenon in the life history of plants as it is directly correlated with the yield. Obviously, it forms an important stage in economically important plants also. In the present investigation an attempt was made to study the physiological processes during pod development in C.cajan and P.tetragonolobus. The growth and development of pods right from fertilization to maturity was studied at different development stages.

In the investigation, the physiology of C.cajan (Var. ICPL-87) and P.tetragonolobus pods with respect to mineral nutrition, carbohydrate metabolism, and nitrogen metabolism has been studied.

To study all these concepts recent and advanced techniques and methodology were employed. The methodology includes, flame photometry, spectrophotometry and atomic absorption spectrophotometry.

Significant findings of the investigations can be summarized as follows:

(1) Pod Developmert:

As the pod grows, there is increase in Pod length and breadth. During young stage pods are tender and accumulate less proteins, carbohydrates and minerals; as pod grows and approaches its maturity, it becomes long and broad and becomes hard. Nitrogen, protein, carbohydrate contents increase.

(2) Moisture Content:

The fresh weight of seeds and pod cover in C.cajan (Var. ICPL-87) and P.tetra. showed increase from 10 days to about 35 days after anthesis. Then 35 days after anthesis, seed and pod cover dried resulting in decline in fresh weight. Dry weight recorded steady increase with pod growth reaching a constant value. When pod completely matured there was complete reduction in moisture content.

(3) Nitrogen Metabolism:

(a) Total Nitrogen Content:

Total nitrogen content in seeds of C.cajan and P.tetragonolobus increased till the end of maturity. Pod cover is involved in the translocation of nitrogenous substances to the developing seeds in the pod. Pod cover showed a gradual decrease in total nitrogen content during later phase of pod development.

(b) Nitrate and Nitrite Reductase Activities:

Nitrate and nitrite reductase activities were lowered as the pod matured. During young stage of pod development, seed and pod cover of C.cajan (Var. ICPL-87) and P.tetragonolobus showed more nitrate and nitrite reductase activity. Thus findings indicate an active nitrogen metabolism during initial stages of pod development in both these legumes. This may possibly contribute to high protein status of the seeds.

(4) **Proteins:**

It is a common feature of C.cajan (Var. ICPL-87) and P. tetragonolobus that matured seeds have high protein content. Total protein in C.cajan (Var. ICPL-87) seed was low till 10 to 25 days after anthesis and then there was rapid increase till the 40 days after anthesis. Pad cover showed opposite trend. Initially protein contents were low and then there was rise in their content and afterwards there was decrease. P.tetragonolobus seeds had higher protein content in the later phase of development. Protein content in pod cover was more during initial stage of pod development in P.tetragonolobus and then it decreased till the end of maturity.

(5) **Proline:**

Seed and pod cover of C.cajan showed less free proline content as compared with other leguminous plants. Proline content decreased during senescence which may be taken as an indication of disturbed nitrogen metabolism. Thus, it is apparent that although proline plays a major role in stress physiology of many crop plants, it is very insignificant is developmental processes in the pods of legumes.

(6) Chlorophylls:

Studies with chlorophylls in the pod revealed that during pod development, chlorophylls accumulate upto the maximum level and afterwards the rate of synthesis of chlorophyll content was significantly reduced to become dry. The presence of chlorophylls in the pod tissue of these two legumes clearly indicates a good potential of photosynthesis.

(7) Carbohydrate Metabolism:

Carbohydrates provide the main source of energy for respiration. As concerned with carbohydrate level in C.cajan (Var. ICPL-87) and P.tetragonolobus, reducing sugars increased in the 30 days after anthesis; while insoluble carbohydrates were incresed 25 days after anthesis. In the pod cover level of reducing sugars was increased from 10 to 30 days after anthesis and later decreased, while the amount of total sugar and insoluble carbohydrate was increased from 10 to 40 days after anthesis and during later developmental stages it was decreased. From the above observations it can be concluded that pod cover plays a major role in respiration of pod and as pod becomes senescent and dry there is decline in the photo-synthetic activity which leads to decline in the level of assimilates.

α-amylase is one of the important enzyme systems of the carbohydrate metabolism. α-amylase activity was maximum during initial stage of pod development and later on there was decline in enzyme activity. The high activity of α-amylase during initial phase may provide sugars for respiration and growth of the pod.

(8) Polyphenols:

Polyphenols have been shown to be antiphysiological substances in food legumes. Polyphenol reduces digestibility of protein and availability of mineral and vitamns. In C.cajan (Var. ICPL-87) there was significant reduction in the polyphenol content of the seed during its maturation. This decrease in polyphenol content may be due to polymerization of existing phenolic compounds producing high molecular weight insoluble polymers. Pod cover of C.cajan (Var. ICPL-87) also showed decreased level of polyphenols as pod cover dried.

(9) Mineral Nutrition:

Na^+ showec more accumulation between 15 to 35 days after anthesis in seed and pod cover of C.cajan (Var. ICPL-87). In P.tetragonolobus, Na^+ accumulated more in the juvenile stage in seed and pod cover during pod development.

In C.cajan (Var. ICPL-87) K^+ accumulation was more in seeds in pod cover and highest between 15 and 20 after anthesis. K^+ content decreased rapidly between the period 40-50 days after anthesis in P.tetragonolobus and slight increase was noticed till 60 days after anthesis.

Ca^{2+} accumulation was more in the young pod. Seeds contained more Ca^{2+} during early stage of development in C.cajan (Var. ICPL-87). In P.tetragonolobus pod cover accumulated more Ca^{2+} in the early days of development which was followed by steep decrease till 60 days after anthesis. While the tissue in seed time of this legume Ca^{2+} accumulated was more in early days; then there is fluctuation and rapid loss till the seed gets dry.

Phosphorus is an essential element and was found to decrease and the pod become dry in C.cajan. In P.tetragonolobus P^{5+} accumulation was more in seed and this process continued till the full development of seeds. On the other hand the P^{5+} content showed a rapid loss during drying of the pod.

Mg^{2+} and Mn^{2+} were more in pod cover and their accumulation was increased between 15 and 30 days after anthesis in C.cajan (Var. ICPL-86) pods. Seed showed relatively poor accumulation of these elements.

Zn^{2+} and Cu^{2+} were found to be more in seed between 15 and 30 days after anthesis in the case of C.cajan. Pod cover accumulated less Zn^{2+} and Cu^{2+} as compared to seed tissue.

Iron and nickel were more in pod of C.cajan. Then due to translocation of these elements to seeds their rate of accumulation in the pod was decreased.

It is apparent from the foregoing account that pod development process of C.cajan and P.tetragonolobus bean is quite interesting and it is characterised by marked changes in the nitrogen nutrition, carbohydrate metabolism and mineral accumulation processes. Only a detailed study of the enzymes involved in these processes will throw more light on this process.