GENERAL INTRODUCTION
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In spite of a major shift from agriculture to industry particularly over a period of past few decades, agriculture remains to be the main prop of our national economy. Fruit growing is an important aspect of the agricultural industry and is called upon to supply the population with nutritious and delicious fruits of all kinds. Fruits of all kinds in general and soft fruits in particular contain considerable quantities of sugars, proteins, oils, various minerals, organic acids and aromatic substances as well as vitamins. Thus, they constitute an important part of human diet. Fruits can be processed into a variety of fruit products: dried fruits, jam, jelly, syrup, marmalade, juice and wine etc. This makes it possible to supply the population regularly with the products of fruit growing industry all the year round. Besides, fruit plants are truely health builders. They reduce winds, improve the composition of air and beautify recreation centres. Thus, fruit growing can be considered as a vitally important section of the agricultural industry.

According to USSR Academy of Medical Sciences the annual human diet should include about 100 Kg of fruit. Fruit growing industry of India should take a note of it and should strive to fulfil this target. But strangely enough annual fruit consumption
by an individual remains too short in our country. This can be fairly well understood. The per acre yield figures of soft fruits are unfortunately very low and the area under fruit cultivation is also very small as compared to developed countries. In addition to this, horticulture has not been scientifically developed and research work in this field has been very much neglected. Further, proper modernization and mechanization of agriculture as a whole to ensure rapid increase in the yields so as to satisfy the growing needs of society could not be attained. On the other hand, colossal losses suffered on account of damages and diseases caused by plant pathogens is yet another important factor in reducing the productivity. A report based on the survey of Delhi market by Chenu and Thakur (1968) where 10.68% losses for apples, 31.49% for banana, 17.73% for mango, 24.02% for potato and 19.32% for tomato have been estimated would provide the data to emphasize the point. This has adversely affected the fruit growing industry of our country. As such, this calls for an urgent attention of the plant pathologists.

Days of classical pathology have elapsed, when diseases were superficially described and cured without much insight and rationale by the old plant pathologists. Now it has entered into the experimental phase where biochemistry, physiology and other allied branches of science have come to play a role in elucidating the physiology of disease. Initial understanding of disease comes from the efforts of pioneer workers like De Bary (1886),
Ward (1888), Jones (1909) and Brown (1915). Since then a large number of workers like Bateman (1963, '68), Horsfall (1959), Albersheim (1969), Wood (1967), Dimond (1971), Byrde and Cutting (1971) have greatly contributed to advance the knowledge by unravelling the deep seated mechanisms of disease development. Consequently, a new concept of disease has evolved. Disease is now recognized as a manifestation of several complex interactions going on between the host and the parasite.

Plant diseases, particularly 'rots' are caused by the participation of certain specific enzymes which are either secreted by the pathogen into the host or are produced as a result of host-pathogen interactions. These enzymes then decompose the cell walls and other constituents of the host and pathogen invades deeper by killing cells and utilizing the nutrition of the moribund cells of the host. Toxins and other factors produced by the pathogen disturb the normal functioning of the host (Luke and Wheeler, 1955; Leal et al., 1965; and Wood, 1972) and facilitate the pathogen in overcoming the resistance of the host. The host, on the other hand, also reacts against the invading pathogen by its own defence mechanisms, which involve the production of fungitoxic substances including phytoalexins and phenolic substances, resisting against the disease development. During this fray in between the host and the pathogen several important physiological and structural changes
take place which ultimately result into a disease syndrome (Walker and Stanman, 1955; Cruickshank and Perrin, 1964; Higgins and Millar, 1967, '68; Kuc, 1966, '72; and Heath and Wood, 1971). An adequate understanding of these aspects of disease is essential in devising precise control measures.

A great deal of work has been carried out in India and abroad on the post-harvest spoilage of fruits and vegetables mostly caused by phytopathogenic microorganisms. Papers on these problems are appearing quite frequently at short intervals. Black rots of apple caused by Physalospora malorum, Diplodia mutila and Monilia cinerea were reported by Stevens (1941) and Wormald (1945). Wardlaw and Leonard (1937) found Botryodiplodia theobromae associated with the storage disease of grape fruits. Singh (1942) has mentioned about the diseases of fruits of Kumaon area. Decay of certain fruits in storage conditions has been reported by Sinha (1946). Hingorani et al. (1960) studied mango blight caused by Macrophoma mangiferae. Green and Goose (1963) isolated Botryodiplodia theobromae from rotted boxed bananas. Bhargava and Gupta (1957), Chandra and Tandon (1963), Shrivastava et al. (1964), Mehrotra (1964), Ray (1965), Rao (1965), and Tandon (1967) have provided a comprehensive list of various vegetable and fruit rot diseases on the basis of surveys of markets and storage diseases in several different localities of India. Desai and Pathak (1969) worked out some pathological details
on soft rot of *Luffa cylindrica* caused by *Pythium butleri*. 
Rai (1971b) has made the physiopathological investigations on the *Colletotrichum* rot of chillies. Jamaluddin et al. (1972) have given a detailed pathological account on the storage diseases of apples. Gangopadhyay and Kapoor (1973) have studied the fruit rot of *Cucurbita pepo* incited by *Alternaria cucumerina*. Post harvest infection of apple by *Trichotheccium roseum* has been reported by Sreekantiah et al. (1974). Garg /investigated the fruit rot of lemons caused by *Geotrichum candidum*. Sharma et al. (1979) have recently held *Fusarium solani* responsible for the soft rot of *Aegle marmelos* fruits.

In addition to the surveys, reports and physiopathological investigations made in relation with the fungal diseases of various fruits and vegetables, several workers have also attempted to provide suitable control measures for these diseases. Schmidt (1964) suggested some fungicidal treatment for the control of anthracnose of melons caused by *Colletotrichum lagenarium*. Efforts to control anthracnose, soft rot and downy mildew diseases of cucumber caused by *C. lagenarium*, *Rhizoctonia solani* and *Pseudoperonospora cubensis* respectively, were made by Jones and Evernett (1955). *Fusarium* fruit rot of *Cucumis melo* could be controlled by bleaching powder and potassium permanganate (Raina et al., 1968). Shrivastav and Tandon (1969) successfully employed nystatin to control *Botryodiplodia* rot of guava. Pathak et al.
(1971) used certain fungicides for the control of Rhizopus and Diplodia rots of mango fruits. Dharamvir and Ashok Gaur (1973) applied fungicides and a few antibiotics to check anthracnose of guava incited by Colletotrichum psidii. Similarly, storage rot of mango caused by C. gloeosporioides was controlled by Sohi et al. (1973) with a mixture of formalin, aureofungin and captan. Singh and Bhargava (1974) also used a few fungicides and antibiotics as a remedy for Geotrichum rot of citrus fruits. Bhargava and Singh (1975) have also suggested a fungicidal dip treatment for the control of storage rot of mango fruit caused by Aspergillus Sp. Garg (1976), Thind (1977), and Mutalal (1979) have recently employed certain chemical substances like fungicides, antibiotics, phenols and essential oils to control the soft rot diseases of lemon, apple and cucumber fruits caused by Geotrichum candidum, Clathridium corticola and Pythium deliense respectively. Foreign workers including Brown (1935), Christoff and Christova (1939), Cash Mary (1943), Krejcová (1961), Edney (1970), Hasegawa et al. (1972), Jacobs et al. (1973) and Parpia (1976) have contributed a lot on this subject.

Storage decays of perishable fruits and vegetables can also be minimized by adopting certain physical control measures, such as modified storage atmospheres, temperature regulation, Demey, refrigeration and hot water treatment etc. (Herner and Dilley, 1969; Ryali and Pentzer, 1974 and Demey, 1977).
A useful account of the market diseases and disorders of most of the fruits and vegetable crops can be had from a series of handbooks published by JS Department of Agriculture. Reviews worth mentioning in this connection are those of Eckert and Sommer (1967) and Harvey (1973).

Sagar is one of the main centres for trade in fruits and vegetables in Madhya Pradesh. Because of defective methods adopted during post harvest transit and storage and lack of sanitary environment, much of the produce is perished due to microbial attack and rendered unfit for human consumption.

The losses could be minimized, if the methods adopted are improved, developed on scientific lines and carefully implemented. Proper plucking and packaging of the products can reduce not only crushing and bruising but can also reduce moisture loss and prevent the spread of rot from infected to sound fruits. An integrated approach of protective preharvest treatment in the fields and orchards and post harvest treatments in packing and storage godowns along with the proper refrigeration can for the most part reduce post harvest holocaust of the fruits and vegetables. Advanced technologies in the production, harvesting, packaging, transport, storage, distribution and retailing of fruits and vegetables can only guarantee a regular supply of fresh and healthy fruits to the consumers.

In Sagar a large number of phytopathogenic diseases of fruits and vegetables have been reported and investigated by several
workers (Rai, 1971; Vyas, 1971; Garg, 1976; Third, 1977 and Muthal, 1979). Soft rot of pear (Pyrus pyrifolia) is also such a commonly observed disease in the market of Sagar. The causal organism, Botryodiplodia theobromae produces soft rot symptoms on pear fruits and steals of its valuable nutrients rendering the fruit unfit for consumption, thereby lowering its market value. Hence, this disease caused by B. theobromae was undertaken for the present research work. Attempts to study the problem from the biochemical, physiological and pathological view points have been made. It is also proposed to evaluate certain chemotherapeutic agents against the fruit rot disease so that enormous losses incurred could be prevented or reduced. The work is planned as follows:

Part I  (Host, pathogen and pathogenicity)

Section A - deals with the description of the host, the pathogen and the disease.

Section B - describes pathogenicity tests, inoculation experiments; effect of temperature, humidity and age of culture on the disease development.

Part II  (Studies on metabolites)

This part involves quantitative and qualitative analysis of metabolites with special emphasis to post-infectional changes in amino acids, sugars, organic acids, phenolic compounds, vitamin C, total carbon and nitrogen contents
of the host tissues.

Part III ( 'in vivo' Enzymological Studies )

This part deals with the studies on the 'in vivo' production of pectolytic, cellulolytic and amyloytic enzymes in healthy as well as diseased fruits at different stages of disease development.

Part IV ( Control Measures )

In this part, various chemotherapeutic agents like fungicides, antibiotics, phenolics and volatile compounds have been tested against B. theobromae with a view to select the effective ones for the control of pear fruit rot. In order to understand the mode of action of these fungitoxicants, their effects on the activity of cellulolytic enzymes and oxidative metabolism of the pathogen were also investigated.

Part V General Summary Miscellaneous

Bibliography