

SOME ASPECTS OF TEMPERATE ZONE FRUIT CULTURE IN THE HIGHLANDS OF CEYLON

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INTRODUCTION

ATTEMPTS have been made in the past, as far back as 1890, by the Department of Agriculture to introduce and cultivate various kinds of temperate zone fruits in the highlands of Ceylon. Records are available of such undertakings made by a former Superintendent of the Botanic Gardens Hakgala (elevation about 5,500 feet) who had worked on several imported varieties of pome—, stone—and small fruits. Special mention has also been made of a variety of blackberry bearing fruits of good size and flavour (5). Even before this time, it is known that enthusiastic planters tried to cultivate in their up-country home gardens fruits of this nature.

It is apparent that most of the temperate zone fruits introduced to Ceylon were not adaptable to the local conditions obtaining in the higher elevations of the country. The fact, however, that a few of the varieties have merged into the up-country vegetation and are found today in certain areas to be yielding fairly good crops of fruits popular in the market provides the basis for further investigations on the cultivation of the temperate zone fruits in this part of the island.

Growing of temperate zone fruits in the highlands of tropical countries is not peculiar only to Ceylon. There is evidence of successful fruit cultivation in other tropical countries with similar agro-climatical conditions. Commercial cultivations have already been established in the Kenya Highlands (1) and in the Nilgiris in South India. A close study has also been made on the cultivation of these fruits in Java, Philippines, Mexico etc.

Under the auspices of the American Society of Horticultural Science a seminar on the cultivation of temperate zone fruits in tropical countries was held in Mexico in June 1962, and in 1963 the International Horticultural Congress at its sessions in Brussels resolved to

further research on this subject by establishing a reference collection to study the behaviour of all cultivars of temperate zone fruits in mild climates, especially in the highlands of tropical countries.

LOCATION AND CLIMATOLOGY

The region where temperate zone fruits are found to grow in Ceylon is between 3,500 feet and 6,500 feet in elevation. Two distinct agro-climatical zones are met with in this region, the wetter area experiencing the full blast of both the south-west and the north-east monsoons with an annual rainfall of about 90 ins. (2,250mm) and the drier tracts exposed to the north-east monsoon only and having a rainfall of about 60 ins. (1,500 mm). Over the latter zone, comprising of the rain-shadow areas of the hills, a strong dry wind blows during the south-west monsoon from June to September.

In the wetter region the annual rainfall follows a bimodal pattern corresponding to the two monsoons with occasional thunderstorms in between. The greater part of precipitation occurs during the major north-east monsoon (October-March) and the rest during the south-west monsoon (April-September).

Two marked growing seasons thus exist corresponding to the two monsoons. A rainfall distribution of this nature, with intermittent dry periods, encourages sudden growth flushes and erratic bearing in some of the locally grown temperate zone fruits. This peculiar behaviour occurs in the wetter areas, while in the drier tracts there is a distinct fruiting period, and fruit cultivation follows the normal pattern.

During the "cold season" from December to February, day temperatures are in the range of the sixties, while the night temperatures rarely go down below 50°F. Only an occasional frost of a few hours duration is experienced, above the 6,000 ft., elevation. In spite of these sudden drops in temperature, not more than three hundred hours at or below 50°F. are obtained—a type of chilling characteristic of the tropics.

PRESENT STATE AND SITES OF CULTIVATION

The temperate zone fruits of any commercial value grown under up-country conditions are the "Local Pear", the "Ragala Apple"

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and the "Local Peach" sometimes referred to as the "Red Ceylon Peach". Other kinds of fruit like plums, strawberries and raspberries are of minor importance.

In keeping with the general trend all over the Island, no proper system of fruit cultivation is being followed. All the fruits are grown mixed on home garden scale, and well-established and organised orchards such as those found in other fruit-growing countries are very rare.

The standard of cultivation in local home gardens is generally poor. The trees are allowed to grow naturally without any heed to the basic principles of training and pruning. The maintenance of soil fertility, and the control of pests and diseases have received scant attention.

The cultivation of the "Local Pear" is confined mainly to Nuwara Eliya (elevation 6,200 ft.) and the neighbouring areas with similar wet conditions prevailing during both monsoons. The only variety presently grown is of an inferior cooking type, consumed in the local market mainly as dessert fruit. Canning of these pears has given fairly good results.

The pear is propagated vegetatively by hard-wood cuttings, very similar to the method followed in the Nilgiri Hills of South India where the same variety is cultivated. In the wet areas, the trees remain evergreen with very little leaf abscission. Flowering and fruiting appear to be erratic. The major flowering phase is spread over two and a half months from mid-July to September with the peak of fruiting in March to April.

Complete defoliation and dormancy of the same pear is observed when grown in the rain-shadow areas of the up-country. This occurs during the "winter months" of December to January. Here the fruiting time is well-defined and the crops come into readiness only in August to September.

The cultivation of the 'Ragala Apple' has met with failure in the wet locations where the pear thrives. The Ragala apple seems to grow well only in the drier parts of the up-country, predominantly in the Ragala region (elevation 5,500 ft.), an area that can be considered the home of the local apple.

The popular variety cultivated appears to be a cooking apple of unknown origin. A few scattered trees of a "sweet apple" variety

are also found in some gardens. This variety, however, has not attained popularity due to the fact that it is a very shy bearer, though the flavour of the fruit is superior to that of the "Ragala Apple".

The propagation of the "Ragala Apple" is solely done by suckers. The trees come into bearing within three to four years and reach their full bearing stage after the tenth year. Trees as old as fifteen years yielding between 700 to 1,000 fruits are not uncommon.

Since the Ragala region falls within the rain-shadow range, the growth cycle of the apples is somewhat identical to that of the pear grown under similar conditions. In this connection it is worth mentioning that the "Ragala Apple" behaves differently when grown at lower elevations, for example at Gurutalawa (elevation 4,000 ft.). Here the climatic conditions are similar to that obtaining at Ragala, the only difference being that the mean annual temperature is somewhat higher. This results in erratic bearing habits without a marked dormant period and leaf abscission.

Analogous to the apple, the "Local Peach" is found mainly in the drier parts of the up-country with the focus of cultivation between 3,000 ft. to 4,500 ft. contours. The trees produce heavy crops of sub-acid hard fruits of inferior quality, consumed in the local market usually in the processed form. Fruit thinning is not a common practice adopted by growers, and this results often in small sized fruits. The "Local Peach" is propagated mainly by seed. As a result the trees exhibit a wide diversity of characters.

At all elevations in the up-country where the peach is grown, trees go through a distinct period of rest (December to January). Flowers appear in February and fruits ripen by May to June.

Of the temperate zone fruits of lesser importance in Ceylon, the cultivation of *Strawberries* has caught on in recent years in the wetter areas around Nuwara Eliya. Different varieties of strawberries have been introduced and these have varied widely in regard to their adaptability to the environmental conditions, to yield and fruit quality and runner formation.

GROWTH PATTERN

In their natural habitats all temperate zone fruits are deciduous. During the warmer months they complete their vegetative and reproductive phases. Flower bud initiation for the next year's growth occurs before the winter sets in. With the approach of the colder months, visible growth ceases, leaves are lost and the plants

come to a stage of distinct rest. Under these climatic conditions, this pattern of plant growth is essential for survival as low temperatures, just below freezing point, could permanently injure actively growing plant tissues. Mechanism of this nature whereby plants are protected by a state of dormancy during periods of freezing temperatures has been responsible for their adaptation to extremes of climate in this zone.

Weinberger (16) states that the mechanism involved is called "rest" and the stage at which buds are unable to grow—even though external conditions are favourable for growth—is referred to as the "rest period". This rest is of special advantage in the early winter and the early spring when temperatures may be high enough for bud burst, and when freezing temperatures are liable to occur.

The rest influence operating within a deciduous plant is still not fully understood but it seems to be controlled by certain growth regulators.

CHILLING REQUIREMENTS

In areas adjacent to the sub-tropics, warm winters are sometimes experienced with the result that fruit trees behave peculiarly in the following spring. Flower and leaf formation become irregular, are often delayed and only apical buds burst. This phenomenon is called "prolonged dormancy" or "delayed foliation" (10) and has aroused much interest among workers in regions like Southern California, Florida, Mississippi, South Africa, Israel, etc. where the effect of mild winters has become a hazard to fruit growers.

It has been found from experiments conducted into the behaviour of deciduous fruit trees that the application of sufficiently low temperature or "chilling" is essential for breaking the rest period and forcing buds to grow when the external environmental conditions become favourable. These investigations have also revealed that there is a varietal response on chilling, certain varieties needing as much as 1,200 hours of effective chilling (at or below 45°F.) while others require only about 250 hours (13).

There is also evidence to show that the rest period of a particular variety can only be broken if the chilling duration required is given in one spell. Periods of low temperature interspersed with high temperature counteracts the cumulative effect of chilling (9).

In the higher latitudes, however, the chilling requirements of the temperate zone fruits are always satisfied and the growth pattern of these fruits never deviates from the normal.

In certain years, unusually high temperatures during late fall cause the bursting of the already developed flower buds before the advent of the winter. This phenomenon has been explained by Chandler (4) who stated that a higher twig temperature of about 113°F. was sufficient to break the rest.

Though Ceylon is situated in the tropical belt (between the 6th and 10th degrees northern latitude) the highlands of this island experience a near sub-tropical climate. In Ceylon, chilling of the type mentioned earlier is not found save for a few hundred hours duration of temperatures below 50°F. in the cooler season between December and January. Therefore, the problems found here are almost identical with those confronted by researchers in the sub-tropical regions in years when warm winters occur.

As the temperate zone fruits already existing in Ceylon are of inferior nature, a scientific approach to the problem of improvement of fruit cultivation would involve a comprehensive study of varieties introduced from the lower latitudes of the temperate zone and the sub-tropics.

In the lower sections of the up-country of Ceylon (elevation between 3,500 ft. and 5,000 ft.) where temperatures bringing about effective chilling are not experienced at all, the application of certain chemical defoliating agents could be used to advantage within reasonable limits to break the rest period of dormant buds.

Spraying a seven per cent solution of DNOC with the advent of the north-east monsoon rains in October has been found to be very promising when used on the local "Ragala Apple". This treatment is best given at this time and not at the normal flowering season in March to April in order to avoid heavy losses of the crop by strong winds prevailing in July to August. There is also evidence of the use of oil emulsions of DNOC (Ovamorte, Ovicide or Dytrol) on a commercial scale by a fruit grower in the Kenya Highlands (1).

In certain other places like South Africa, raw linseed oil or seal oil, about two to five per cent emulsion in water, has been used successfully to induce buds to open earlier and more uniformly.

CONCLUSIONS

In this article the present status of temperate zone fruit culture in the highlands of Ceylon has been discussed.

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Since recent interest has been evoked internationally on the growing of fruits of the temperate zone in tropical countries, where the consideration of the chilling requirement plays a dominant role, an attempt has also been made in this article to relate some of the problems involved with those found elsewhere in similar environments.

The favourable performance of some temperate zone fruit varieties in the higher elevations of this tropical country opens new vistas for their cultivation and improvement. The present programme of work undertaken in this connection, therefore, embraces the establishment of model nurseries and orchards, the introduction of foreign stock and scion materials and stock-scion investigations in different soils and elevations.

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