

TOMATO CULTIVATION IN THE DRY ZONE OF CEYLON—I

W. R. C. PAUL, M.A., M.S.C., D.I.C., F.L.S.,
DIVISIONAL AGRICULTURAL OFFICER, NORTHERN

INTRODUCTION

WITHIN recent years there has been a growing interest taken in the production of tomatoes, particularly from the dry zone areas of Ceylon where conditions for the cultivation of this crop are generally more favourable than elsewhere in the Island.

The popularity of the tomato may be largely ascribed to its particular flavour and attractiveness as a slicing vegetable as well as to the increasing recognition of its nutritive value. It is now widely regarded as one of the most esteemed table vegetables and according to Carver (1918) can be prepared in 115 different ways, both raw and cooked. For canning and the manufacture of various tomato products it is pre-eminently suitable and ranks first amongst the vegetable canned crops of the United States.

In food value, tomatoes have recently come into much prominence. They are found to be particularly rich in mineral salts such as phosphates and potash though deficient in calcium. They have a high percentage of moisture in all stages of the fruit and their fibre content is low, making them easily digestible. As a source of vitamins they are invaluable; the ripe fruits have been found to contain relatively large quantities of vitamins A, B, and C and experiments carried out in U. S. A. have shown that the fruits which are allowed to remain on the plant until they are ripe are higher in vitamin C than those which are picked green and ripened in storage. It is of note that the vitamins in tomatoes are almost unchanged by cooking or by treatment with ethylene gas for the artificial colouring of unripe fruits. Furthermore, the canned ripe fruits and preserved juice manufactured according to modern processes are almost as rich in their vitamin content as the fresh ripe fruit. The importance of tomatoes as a result of their richness in vitamins in the diet of the peasant

population that are ill-nourished in the malarial districts of Ceylon cannot be overestimated. The vitality and general resistance of the people are increased and malarial infection is thereby greatly reduced.

In many temperate countries, tomatoes are regarded as one of the chief vegetable crops and are intensively raised in glass houses, as a farm crop in the field, in market and in home gardens for the following purposes: 1. Local markets. 2. Export. 3. Canning and manufacturing. 4. Seed production.

In the tropics, however, the crop is relegated to a comparatively minor position and is mainly produced in peasant allotments and home gardens for sale in local markets. It is, however, proving increasingly attractive even in districts of limited markets and, in comparison with most other annual crops grown in the tropics, the yields and return per acre are high. But unless wider markets can be secured there is a danger of overproduction and consequent wastage owing to the perishable nature of the fruit.

The increase in the demand for tomatoes and the improvements that have taken place within recent years in the methods of growing and marketing the crop have made it possible to extend its markets especially from the more remote areas of production and to export it to other districts and countries particularly during seasons of shortage and favourable prices. In the export overseas of tropically grown tomatoes considerable success has been achieved by the smaller British West Indian islands which by reason of a preferential tariff are able to export their tomatoes to Canada during the winter months. In Ceylon, efforts are being made to grow tomatoes in the dry zone for marketing in Colombo. The main difficulty at present lies in the lack of a marketing organisation which can carry out the grading, packing and transport arrangements of the crop.

Apart from growing tomatoes in this way for local and export markets of fresh fruits, the possibilities of canning and of manufacturing sauces, juices and other products require investigation. There is an increasing demand for these products in Ceylon and considerable quantities are at present being imported.

As regards seed production, little or no work has been done in the tropics to produce varieties or strains that are acclimatised or suited to local conditions. It is becoming increasingly evident

that there are strains which are more adapted than others to particular localities which show differences of soil and climate. At present, nearly all the better grade varieties of tomatoes under cultivation are from seed imported from temperate regions and particularly from U. S. A. There is, therefore, much scope for the development of improved varieties or strains that are well adapted to particular areas.

It is of importance that before undertaking an extensive cultivation of tomatoes, the grower must assure himself of a profitable outlet for his crop. He must have a good local market or be in proximity to a manufacturing centre or have facilities for exporting his crop. It does not generally pay to cultivate tomatoes for distant markets except on an acreage sufficiently large to cover freight expenses unless groups or associations of small growers can be formed for pooling their produce before despatch. Tomatoes are generally an intensively raised crop needing much care and attention during the entire season of their growth. The cost of production is, therefore, high and the areas cultivated by individual growers are thus necessarily limited. The crop is also very susceptible to disease, especially under unfavourable weather conditions, such as prolonged wet weather or high temperatures. But the yields are generally large and, with fair prices, high profits can be made. The cultural practices, however, greatly determine the quantity and quality of the crop produced and in many parts of the dry zone tomatoes as grown by peasants do not receive the attention necessary for high yield and good quality. Under intensive methods of cultivation in areas suited to the growing of this crop and with seeds of superior varieties, larger yields can be obtained, but though the total expenditure per acre is greater the net returns are much better.

Very little information seems to be available in regard to the improvement of tomato growing in the tropics and much investigation is needed on questions of yield, varieties, systems of cultivation, seasons for planting, grading, packing etc., in order that the crop may be grown more remuneratively for the particular markets in view. Paterson (1931) has drawn up some preliminary suggestions for laying down modern field experiments on tomato cultivation in the West Indies. Many of these suggestions could well be taken up for investigation in other parts of the tropics so that more information may be gained on

various aspects of tomato cultivation from properly controlled experiments, which with modern field technique would indicate the reliability of the results by valid statistical methods.

In view of the increasing interest now being taken in this crop in Ceylon, the object of this paper is to give a detailed account of the methods of cultivation of tomatoes based on the available information. Much of this, however, is compiled from data obtained from work originally carried out in U. S. A. where such results were found applicable to Ceylon conditions.

CLIMATE

The tomato plant requires a comparatively warm and sunny climate with a light rainfall. In the tropics the rainfall is the chief factor determining the success of tomato cultivation and areas with a total annual rainfall of over 75 inches are not very satisfactory for the extensive cultivation of this crop. The dry zone areas with an annual rainfall of 40 to 60 inches have proved most suitable. During the growing period of the crop which takes about $1\frac{1}{2}$ to 2 months there should be a uniform but not too heavy rainfall and when development and ripening of the fruits take place a dry season with occasional light showers should prevail. In areas of high humidity vegetative growth becomes very marked while fruit development is poor and diseases of both the vines and fruits are excessive. The fruit is also more watery and lacking in flavour when grown during periods of wet weather. It is for these reasons that the crop does best in the dry zone and is planted during the North-East monsoon so that fruiting and ripening takes place in dry weather.

In order to avoid the effect of excessive rains, planting out in the field may be carried out towards the latter end of the monsoon but it may be necessary to resort to irrigation for a short period after the monsoon rains have ceased. In light soils, however, with good drainage planting out can be done with the commencement of the monsoon.

Tomatoes thrive best in a day temperature of 65° to 85°F. Nightingale (1933) has shown that the optimum temperature for vegetative growth is 70°F. but this is somewhat lower than the average which prevails in the dry zone. In a cooler but dry climate such as at Bangalore in South India tomatoes do exceptionally well.

When temperatures are high and moisture in the soil deficient irrigation should be resorted to as otherwise these conditions led to dropping of the flowers and blossom-end rot of the fruits. During the fruiting period there should be plenty of sunshine, cloudy weather being not conducive to the production of good quality fruits. Miss Pfeiffer (1926) found that with 12 hours of light daily the greatest growth was made, while with only 5 to 7 hours' light growth was poor and with 17 hours or more the plants were injured and finally killed. The splendid colour shown by the Italian grown tomatoes in comparison with other temperate grown tomatoes is attributed largely to the amount of sunshine rather than to any superior varieties of cultural practices.

In table I the meteorological data* for two stations in the dry zone are given.

Wind is an important factor in tomato cultivation. The crop cannot be grown successfully in wind blown areas and hot dry winds especially cause dropping of the flowers. It is always necessary to plant tomatoes in sheltered situations or to have wind belts established. Efforts to grow the crop during the dry season when the south-west winds are strong in the dry zone, in spite of irrigation and a certain degree of wind protection have so far not proved very successful. All three factors during that season—strong wind, dry weather and high temperature—militate against success.

VARIETIES

There is a large number of varieties of tomatoes which differ in shape, size, colour and flavour of the fruit as well as in several other characters, such as yield, maturity, etc. Unfortunately scores of varietal names, many of which are misleading and others show no differences of varietal significance, have been given from time to time by seedsmen and growers. There has been a general lack of authentic descriptions of varieties and consequently considerable confusion has arisen as to the characters by which particular varieties may be distinguished and whether such characters are of sufficient varietal value. This need for the standardisation of varieties has been realised by the United States Department of Agriculture (1933) which has published a description of nine principal American varieties of tomatoes cultivated in the States.

* Figures kindly supplied by the Superintendent, Colombo Observatory.

TABLE I

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Anuradhapura													
Mean Rainfall (in inches)	3.97	1.58	2.91	6.87	3.57	1.22	1.25	1.74	3.11	9.72	10.70	8.62	55.28
Mean Temperature F°	75.9	77.9	81.1	83.0	82.5	82.5	83.0	83.2	82.6	80.8	78.7	76.4	80.6
Mean Maximum Temp. F°	82.0	86.3	90.5	91.2	89.2	88.8	90.3	91.1	90.4	88.1	85.5	83.1	88.0
Mean Minimum Temp. F°	69.8	69.5	71.6	74.7	75.8	76.2	75.7	75.2	74.8	73.4	71.8	69.6	73.2
Jaffna													
Mean Rainfall (in inches)	2.91	1.25	1.15	2.08	1.83	0.61	0.84	1.47	2.79	9.43	14.94	10.57	49.86
Mean Temperature F°	77.5	78.5	81.6	84.5	84.4	83.5	82.7	82.0	82.1	81.0	79.1	77.3	81.2
Mean Maximum Temp. F°	82.7	85.5	88.3	89.3	87.6	86.3	85.9	85.4	85.5	84.9	83.5	82.2	85.6
Mean Minimum Temp. F°	72.3	71.4	74.8	79.7	81.1	80.6	79.4	78.5	78.6	77.1	74.6	72.4	76.7

The tomato plant is capable of great adaptability to its environment and there are differences often shown by a variety which are not large enough to justify a separate varietal name but are sufficiently constant to be regarded as belonging to a different strain. Various strains of the same variety might for example exhibit differences in resistance to a particular disease or in yielding capacity. It is highly desirable that such differences in a variety, while being of value, should not be confused by causing its separation into further varieties. Seedsmen are often tempted to place on the market new strains to which new varietal names are given by them, but if, on the other hand, they endeavoured to meet the demands for the various standard varieties, with whose merits growers are familiar, by supplying better strains of these varieties their reputation would be enhanced. The breeding of new varieties, however, should go uninterruptedly, but seedsmen should not place on the market varieties with new names unless they are really different and superior to those existing.

The modern varieties are a great improvement on the old, flat, angled and furrowed type of fruit which was small in size and of a somewhat acid flavour. This type is still to be seen in cultivation in Ceylon as the 'country' variety and is mainly grown by villagers from their own seed. It is in the temperate countries that the tomato has reached a high degree of perfection, the improved modern variety being a round, solid and smooth—as opposed to furrowed—fruit with a very slightly acid to sweet, juicy flavour. Several of the imported varieties tried in Ceylon under good methods of cultivation come fairly true to type and it is now almost the general custom for the better growers to import their seed regularly. The American varieties have so far proved to be superior both in quality and yield and are more extensively grown in Ceylon.

The varieties of tomatoes can be mainly separated according to Friend (1933) into the following three classes based on the shape of the fruit which is an important character from the commercial standpoint:

- A. Flattened
- B. Flattened globular
- C. Round or globular

On this basis, some of the well-known American varieties are classified below:

- A. Ponderosa, Santa Clara, Earliana (older strains)
- B. Bonny Best, Stone, Earliana (newer strains)
- C. Marglobe, Globe

The flattened types have generally larger sized fruits but there is a much greater tendency to irregularity in shape than with the other two types, the globular showing the most uniformity. From the commercial standpoint not only is the shape of the fruit important but also its uniformity. A variety which shows much variation in the shape of its fruit does not command the same value as one whose fruit is more uniform. There is, however, a certain degree of variation in the shape of the fruit produced from each particular variety, and under unfavourable conditions of soil and climate these variations may be more pronounced. It has been pointed out by the United States Department of Agriculture (1933) that when vegetative growth is excessive the fruits tend to be flatter, while in the case of restricted vegetative growth they become deeper and more globular. Many varieties differ in their degree of variability and there is also the question of variations between strains of the same variety. Balch (1933) has found that seed obtained from different sources under the same varietal name did not always produce the same type of fruit even when grown under similar conditions and it is possible that in this case different strains showing variability in fruit shape were used.

The extent or irregularity in shape was determined by Friend (1933) in a number of varieties and strains tested by him. Where less than 60 per cent. of the crop failed to conform to the varietal type the strain was designated by him as being 'very irregular', where less than 70 per cent. but more than 60 per cent. as 'irregular' and where more than 70 per cent, as 'regular'. Thus varieties can not only be classified according to their fruit shape but also to the extent of variability shown in their shape. In a test on three varieties, Red Rock, Bonny Best and Marglobe, Paul (1934) found that Marglobe showed least variability in shape. The globe types have generally shown the most uniformity while the flattened the least. The marked irregularity of a flattened variety like Ponderosa is familiar to many growers of this variety.

The globe types are generally the smoothest, while the flattened types show the greatest tendency to furrowing. Even in improved varieties like Bonny Best there is a slight degree of furrowing shown at the stem end of the fruit and this lowers the value of the fruit for table purposes in comparison with a fully smooth variety as in slicing a certain wastage marked in the older and degenerate varieties of tomatoes.

As regards size of fruit the effect of environment is well known. A poor soil or unfavourable climate causes the fruits to be small while when conditions for growth and production of fruits are ideal the maximum size of the particular variety will result. There is, however, some variation within certain limits under moderately good conditions for each variety. Some of the flattened varieties like Ponderosa have a larger size of fruits than the Globe, but against this there is a greater tendency to irregularity of shape as previously stated. From the commercial standpoint both size and regularity of shape of fruits are important and medium sized fruits of uniform shape are preferable to those that are large but irregularly shaped. It is for this reason that the Globe or round types are considered best.

Most modern varieties have a deep red colour of fruit and a preference is now shown for this colour to the pink, pomegranate, purple or yellow-skinned varieties.

Yield from the grower's point of view is the chief factor determining the success of tomato cultivation. Considerable variation in yields amongst different varieties has been reported by American workers and the numerous tests that have been carried out have been useful in eliminating the obviously poor yielders which have gradually been superseded by new and improved varieties amongst which only slight differences in yield exist.

Constancy of yield in a variety is a desirable character but environment may considerably affect this character as the tomato plant is very susceptible to unfavourable conditions of soil and climate as previously indicated. But under good conditions it may be assumed that amongst the improved varieties yield does not play an important part or in other words one variety is almost as good as another from the yield standpoint. Most of the yield experiments, however, that have been carried out in the past with tomatoes have generally not been laid down along modern statistical lines so that the results cannot be considered

as statistically reliable. There is need for more yield experiments of varieties to be conducted with the present-day field technique and also over a sufficient period of time—at least three seasons—to eliminate seasonal conditions which may act differently on the varieties or strains under test.

In temperate countries an important consideration is paid to earliness because when the growing season is short late varieties may be killed by frost. In the tropics, however, earliness is desirable in areas where owing to heavy rains planting out is delayed and irrigation facilities are not available.

An enumeration of all the desirable characters in a tomato grown for table purposes is made below:

(1) Round and regular shape, (2) Large to medium size (3) Bright red colour, (4) Smooth skin, (5) Good flavour, (6) Heavy yielder, (7) Early ripening, (8) Good storage quality, (9) Solid flesh, (10) Hardiness, (11) Disease resistance.

The following is a list of some of the imported varieties chiefly American which have been found to do well in Ceylon: Marglobe, Bonny Best, Stone, Earliana, Ponderosa and Mikado.

(to be continued)