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# Bananas—response to temperature

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D.W. Turner
formerly Special Research Horticulturist Tropical Fruit Research Station
Division of Plant Industries Alstonville
(Revised March 2003 by N. Treverrow)

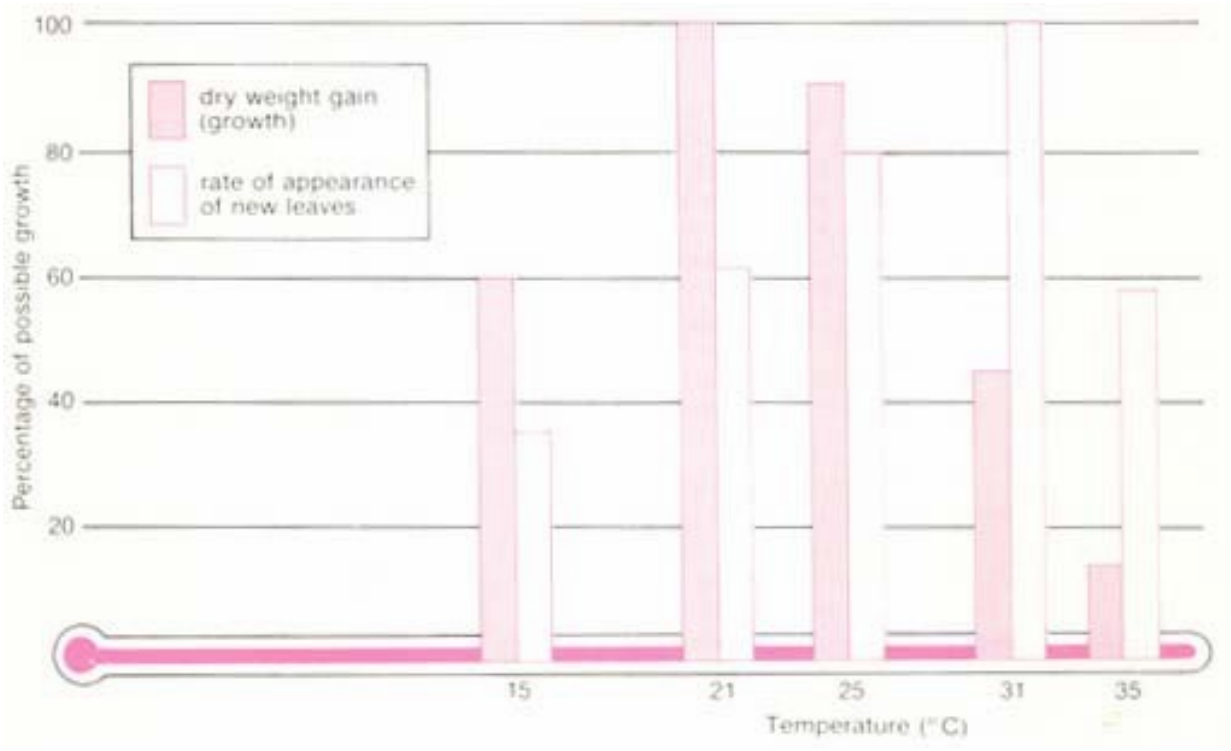
The banana is a plant of tropical origin. When grown in the subtropics, as it is in New South Wales, one of the most limiting factors is temperature. It is therefore important to understand some of the effects of temperature on growth.

## DEVELOPMENT

Plant development is reflected in the rate at which new leaves are produced. While nutrient and water supply can influence the rate of appearance of new leaves, the dominant factor in New South Wales is temperature. The optimum temperature is 31 or 32°C, a temperature reached only in the summer months in the banana growing districts. Leaf emergence stops at about 9 or 10°C.

During the summer, each plant may produce 4 or 5 leaves a month but in the winter only about half a leaf a month.

**Figure 1. Dry weight gain (growth) and rate of appearance of new leaves stop at very high and very low temperatures. Fastest growth is at 21°C and fastest leaf appearance is at 31°C (for Williams variety).**



Temperature also influences the arrangement of the leaves. On plants growing under cool conditions the leaves are more upright, but under wanner conditions they are more horizontal.

While the rate of plant development (for any given variety) is slower in the subtropics than in the tropics, bunch size can be larger and yields are comparable. Maximum yields occur at latitudes of about 15 to 20°C.

**GROWTH**

The amount of growth made by the plant can be expressed as its dry weight. A certain proportion of the dry weight is incorporated into the bunch-usually about one-third. The optimum temperature for growth is about 10°C less than the optimum temperature for the rate of leaf appearance (figure 1). Indeed, for the Williams variety, the optimum temperature for growth is about 21 or 22°C. Growth stops below 9 or 10°C and above 38 or 39°C.

At temperatures above the optimum a greater amount of the carbohydrates made in the leaves is used in respiration in the leaves, pseudostem, corm and roots. So, less is available for growth.

**FRUIT GROWTH**

A bunch emerging in April takes six months or more to.mature, while one emerging in November takes only three months. So temperature has a big influence on the rate of fruit growth, hence the use of bunch covers, which are thought to warm the fruit, thereby increasing growth rate. Bunch covers also reduce the gradient of temperature across the bunch, and fruit from covered bunches is more uniform than that from uncovered bunches.

**UNFAVOURABLE TEMPERATURES**

**Sunburn.** High air temperatures (usually greater than 38°C) and bright sunshine are associated with sunburn damage on exposed fruit, especially on the top hands of the bunch. Care is needed if bunch covers are used. Sunburn can be avoided if a protective covering such as paper is placed between the fruit and the cover, or covers with a reflective coating on one side are used.

**Coping with hot weather.** In hot weather and in bright sunshine the two halves of the lamina (leaf blade) fold downwards (figure 2). This can reduce the temperature of the leaf by 7 or 8° C in the middle of the day. It also reduces, by more than half, the amount of water used by the leaf for cooling. Under still conditions, leaves torn by the wind are cooler than those that remain entire.

In New South Wales the adverse effects of cool weather are seen more frequently than those of hot weather.

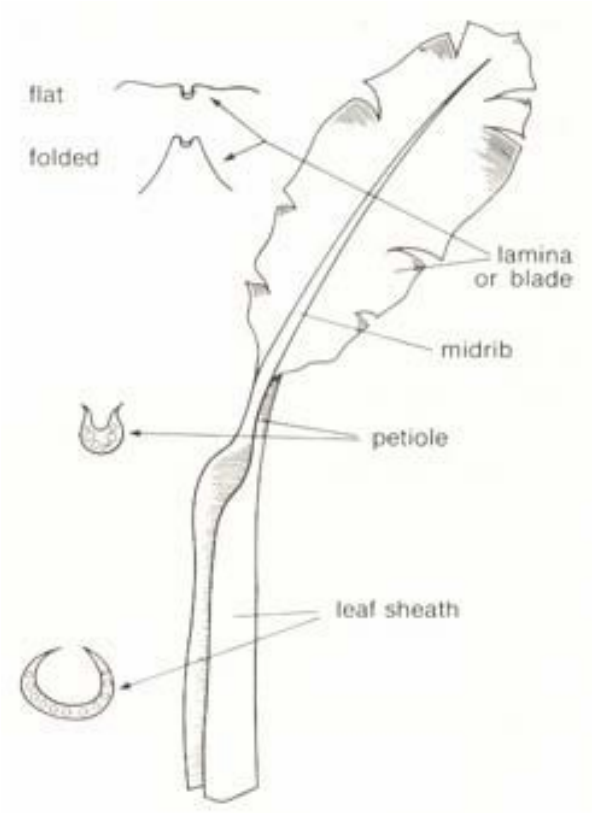
**Choking.** When the distance between the petioles (leaf stalks) of alternate leaves is reduced, the plant takes on a "choked" or "rosette" appearance. This is commonly seen during late winter to early spring. In August; bunches may fail to emerge properly. This is common in Dwarf Cavendish but not so common in Williams variety. Choked bunches are prone to sunburn and produce fruit difficult to pack..

Choking can also be caused by high temperatures (above 30°C) and drought.

**Chilling.** Low temperatures in the plantation and during transport to market can cause chilling of fruit. Whether fruit is damaged or not is a function of time and temperature. Figure 3 gives a guide to the time and air temperature combinations likely to cause irreversible chilling injury in banana fruit. For example, a temperature of 2°C will cause damage only if it lasts for longer than about 45 minutes. Chilling of fruit shows up as watersoaked patches underneath the skin surface. Ripening becomes more difficult and the chilled skin turns black as the fruit ripens.

Chilling symptoms on leaves are not seen immediately but may take 2 to 4 days to appear. The lamina turns yellow. On the emerging leaf, especially in plant crops,

**Figure 2. The parts of a banana leaf.**



the most recently emerged part of the midrib may show brown areas which are watersoaked underneath. On older leaves the symptoms can be similar to potash deficiency symptoms.

In late autumn and early winter, when the first cold snap arrives, the effect on the older leaves can be dramatic, especially if Sigatoka leaf spot and leaf speckle diseases have been controlled. The older leaves break at the petiole and 3 or 4 may hang in a skirt around the pseudostem.

These leaves quickly turn yellow and die**.** Under the cooler conditions the banana cannot maintain all its leaves and the older ones are lost.

**Frost.** Once temperatures drop below freezing, damage occurs quickly (figure 3) and a few hours later the leaves and bunches become watersoaked, then blacken and die. Frost rarely kills the whole plant. It is usually only the exposed tissues which are damaged. Within a few days the youngest leaf begins to emerge again and growth resumes. When plants are completely defoliated by frost the formation of the bunch can be delayed and, if a bunch is already present in the pseudostem, its yield will be reduced. These effects are not seen until some months after the frost has occurred.

**November bunch.** During November, or in some years early December, a bunch emerges on which the fruit is uneven and often deformed. The fruit is tapered, being thin at the stalk end, and the flower end may have a conical, green protuberance. Fruit on the same hand is variable in length. Being short and thick when mature they are often called November dumps. The quality of the fruit is good and has a reputation for being the best tasting of all bananas. However, sometimes very few fruit develop to marketable size.

November bunch has been observed in all subtropical countries where bananas are grown. It is associated with cool winter conditions occurring during the development of fruit on the bunch. The degree of deformity therefore changes according to the coolness of the previous winter.

**Figure 3. The time taken to produce irreversible chilling injury in banana fruit varies greatly. At minus 2°C, it can be as quick as two minutes; at 8°C, it can take as long ac three days.**

| Air temperature | Time taken to reach irreversible chilling injury |
|---|---|
| 8° C | 3 days |
| 6° C | 18 hours |
| 4° C | 4 hours |
| 2° C | 45 minutes |
| 0° C | 10 minutes |
| -2° C | 2 minutes |

## WHAT CAN BE DONE?

To avoid the adverse effects of cold weather:

- maintain good leaf disease control to promote rapid filling of the bunch
- bunch prune heavily to allow rapid filling of remaining hands
- plant in warm localities
- provide shelter from cold westerly winds
- plant near the coast
- avoid frosty areas
- use bunch covers to protect fruit
- grow tolerant varieties (Williams, Ladyfingers, Goldfinger)
- check air drainage-frost pockets can be removed by cutting a hole in the vegetation below the bananas and allowing air to drain away
- cut up plants badly affected by frost; allow the next ratoon crop to develop as soon as possible.

## FURTHER INFORMATION

Further information is available from your local NSW Agriculture district horticulturist.

Artwork: Lyn Burke and Erica Jobling
Editorial assistance: A S. Mitchell and A.T. Munroe
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**DISCLAIMER**
**The information contained in this publication is based on knowledge and understanding at the time of review March 2003. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.**