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# EFFECT OF TEMPERATURE ON THE PRECLIMACTERIC LIFE OF BANANAS

By J. R. BLAKE, B.Sc., and B. C. PEACOCK, B.Sc.

## SUMMARY

**Over the range 60-96°F, green-life of Mons Mari cultivar was found to be logarithmically related to temperature. This is in contrast to an inverse linear relationship obtained previously over the range 55-71° F.**

## I. INTRODUCTION

Few investigations have been conducted which attempt to define the effect of temperature on the duration of the preclimacteric or post-climacteric respiratory phases. Kidd and West (1925, 1936) reported that temperature has quite a marked effect on the post-climacteric period with both apples and pears but little effect on the preclimacteric period. They found that its effect on the former period was defined by $1/t = b\theta$, where t is the duration of the climacteric (onset to peak) and $\theta$ is temperature (°C), b being a constant. Gane (1936) examined the effect of temperature on the post-climacteric life of bananas, and found here that the effect was more closely defined by the formula $\log 1/t = b\theta$.

During recent investigations with bananas (Peacock and Blake 1970), the effect of temperature on the duration of both preclimacteric and post-climacteric phases was examined over the temperature range 55-71°F. Data for the post-climacteric period appeared to fit more closely the inverse linear relationship of Kidd and West than that of Gane. Contrary to Kidd and West (1925, 1936), temperature had a marked effect on the duration of the preclimacteric period (green-life), showing an inverse linear relationship.

This paper reports the results of an investigation aimed at extending some of our previous findings over the preclimacteric period (Peacock and Blake 1970) to higher temperatures.

## II. MATERIALS AND METHODS

The bananas used in this investigation (cultivar Giant Cavendish, Queensland synonym Mons Mari : Simmonds 1959) were obtained direct from a local grower.

Six fruits were held continuously at each of six temperatures, viz. 60, 72, 84, 96, 108 and 120°F. Other conditions and techniques were as described earlier (Peacock and Blake 1970).

## III. RESULTS AND DISCUSSION

The actual green-lives obtained at each temperature are shown in Table 1. Respiration rates at 120°F were initially very high (300-400 mg/kg/hr). They fell rapidly for 2 days, when, in most instances, a rise in respiration occurred. This rise was probably associated with the respiratory climacteric. However, due to the rapidly changing respiratory behaviour, no accurate measure of green-life could be made at this temperature. The mean green-life at 108°F is slightly greater than that at 96°F. Though this difference is not significant it may indicate that, as in pears (Peacock and Blake 1971; Shamel 1917), very high temperatures may actually retard the onset of ripening.

**TABLE 1**

INDIVIDUAL GREEN-LIVES (DAYS) OBTAINED AT EACH TEMPERATURE

| Temperature (°F) | | | | |
|---|---|---|---|---|
| 60 | 72 | 84 | 96 | 108 |
| 22·3 | 12·3 | 6·2 | 3·4 | 2·4 |
| 24·8 | 12·2 | 5·0 | 3·3 | 3·4 |
| 26·1 | 12·4 | 5·3 | 3·2 | 3·4 |
| 24·0 | 14·3 | 5·3 | 2·8 | 3·4 |
| 22·8 | 11·8 | 5·3 | 2·7 | 4·3 |
| 24·5 | 12·4 | 5·3 | 3·3 | 3·3 |
| 24·08 | 12·57 | 5·40 | 3·12 | 3·37 |

Over the range 60-96°F green-life is logarithmically related to temperature (Figure 1), the regression equation for this relationship being

$$\log g = -0.02529T + 2.898$$

where g is green-life (days) and T is temperature (°F). That an inverse linear relationship was reported previously (Peacock and Blake 1970) was no doubt a result of the narrow temperature range examined (55-71°F).

Obviously the term green-life temperature coefficient used previously (Peacock and Blake 1970) only indicated the effect of temperature on green-life over the limited temperature range used, this effect being properly defined by the coefficient (m) and constant (c) of the above equation.

To determine the effect of immaturity on the values of m and c, data previously published (Peacock and Blake 1970) have been used and are reproduced here (Table 2). This table shows the results of an experiment in which four fruit of each of 10 immaturities were held continuously at 60 and 70°F, two fruit of each immaturity being held at each temperature. Green-life was determined by following respiration rates.

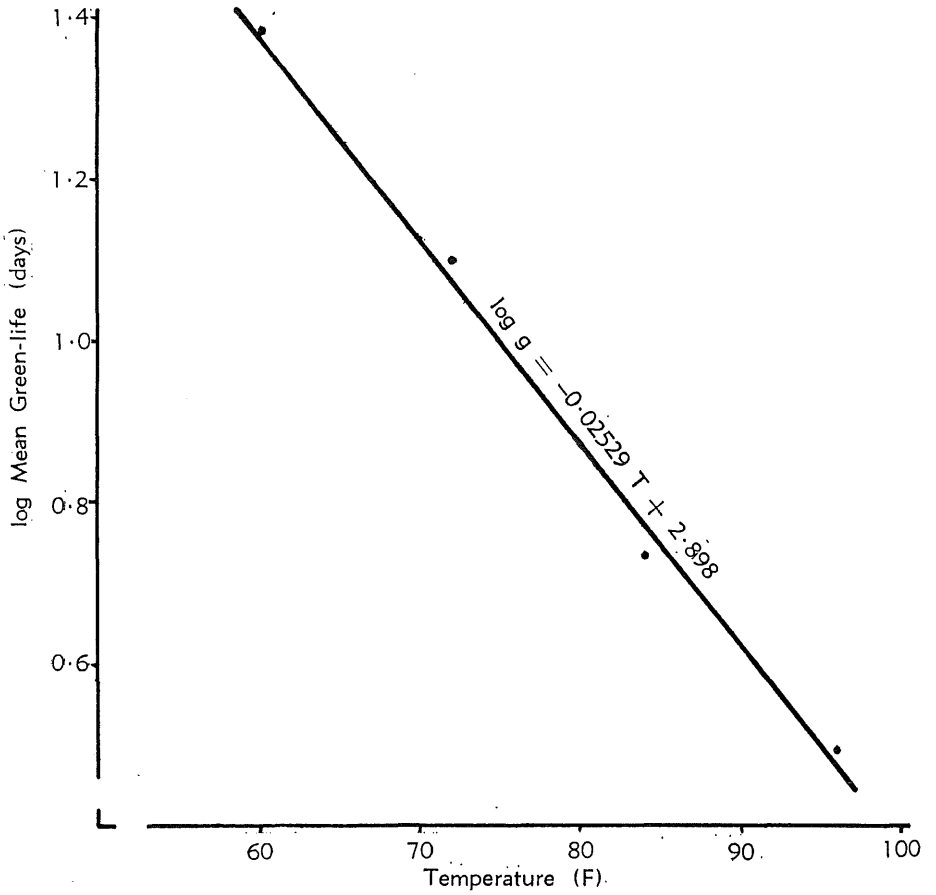


Fig. 1.—Relationship between green-life and temperature.

**TABLE 2**

MEAN GREEN-LIVES (DAYS) AT 60°F ($g_{60}$) AND 70°F ($g_{70}$) FOR A RANGE OF IMMATURITIES*

| Immaturity | $g_{60}$ | $g_{70}$ |
|---|---|---|
| M1 .. .. | 14·9 | 8·2 |
| M2 .. .. | 20·4 | 11·4 |
| M3 .. .. | 21·6 | 9·9 |
| M4 .. .. | 28·7 | 14·5 |
| M5 .. .. | 28·9 | 17·1 |
| M6 .. .. | 29·5 | 18·5 |
| M7 .. .. | 32·6 | 18·6 |
| M8 .. .. | 36·3 | 19·3 |
| M9 .. .. | 36·7 | 21·1 |
| M10 .. .. | 42·5 | 23·8 |

* Data reproduced from Peacock and Blake (1970)

From Table 2, a plot of green-life at 70°F ($g_{70}$) against green-life at 60°F ($g_{60}$) shows a linear relationship (Figure 2). Since this relationship must be of the form:

$$g_{70} = kg_{60}$$

since $\log g = mT + c$,

the following simple calculations will apply

$\log g_{70} = 70\ m + c.$

i.e. $\log k + \log g_{60} = 70\ m + c$ . . . . . (1)

also $\log g_{60} = 60\ m + c$ . . . . . (2).

Subtracting (2) from (1), $\log k = 10\ m$.

The function m is therefore a constant for fruit of different immaturities harvested at the one time and the value of c must therefore be a function of green-life ($c = \log g - K$, where $K = mT$). It can be calculated directly once m and a value of green-life at any temperature are known. The regression coefficient for the relationship shown in Figure 2 is 0·5582, and the value of m from these data must therefore be −0·0253. This value is virtually identical with the value obtained in this present investigation, viz. −0.02529 (cf. Figure 1). These two values of m have been obtained using fruit from the same grower, and, by coincidence, the fruit were harvested at nearly the same time of the year, viz. September and August respectively. It is possible, however, that both m and c could vary between growers, varieties, or times of the year at which the fruit is harvested.

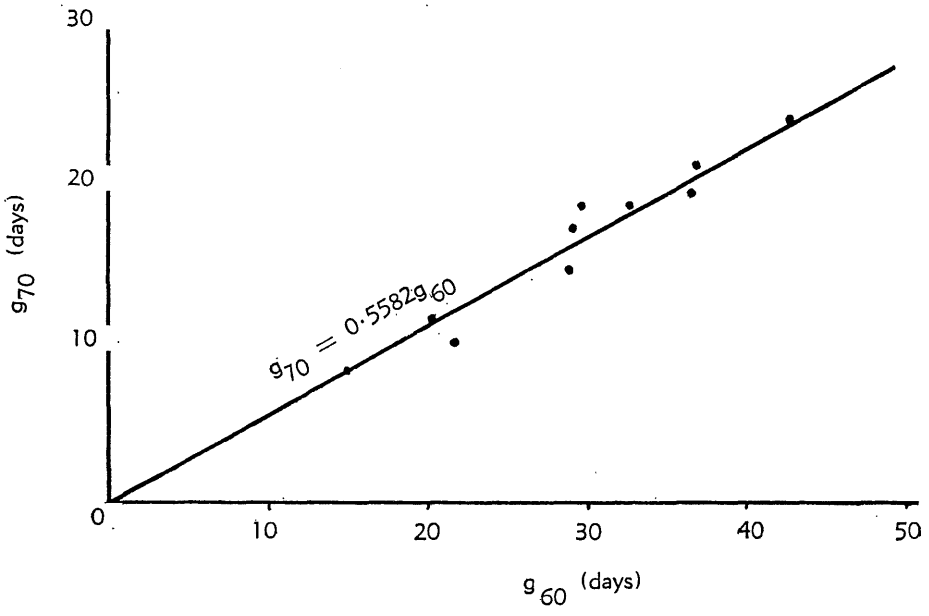


Fig. 2.—Relationship between green-life at 70°F ($g_{70}$) and green-life at 60°F ($g_{60}$).

To determine if time of the year could produce any variation, some previous data (Peacock and Blake 1970) were re-examined (see Table 3). The m values for all data (Tabel 4) show a definite variation with the time of the year at which the fruit were harvested. The apparently sudden change between September and November may be due to the fact that the growing season of the September fruit would have extended right through the winter months, whereas the November fruit would have been "thrown" towards the end of or just after that season.

**TABLE 3**

MEAN GREEN-LIFE (MEAN of SIX FRUIT) IN RELATION TO TEMPERATURE*

| Temperature (°F) | Mean Green-lives (days) | | |
|---|---|---|---|
| 71 .. .. | 19·9 | 10·3 | 13·6 |
| 67 .. .. | 22·9 | 12·7 | 18·1 |
| 63 .. .. | 26·6 | 15·1 | 21·2 |
| 59 .. .. | 30·3 | 20·5 | 25·8 |
| 55 .. .. | 33·4 | 24·0 | 28·1 |

* Data of Peacock and Blake (1970).

**TABLE 4**

EFFECT OF TIME OF YEAR ON VALUE OF THE COEFFICIENT m

| Month of Harvest | m Value |
|---|---|
| August .. .. | 0·0253 |
| September .. .. | 0·0253 |
| November .. .. | 0·0143 |
| January .. .. | 0·0196 |
| June .. .. .. | 0·0236 |

The effect of temperature on the duration of the preclimacteric life of bananas has now been determined, at least for the variety Mons Mari. Whether the logarithmic relationship obtained is applicable to other varieties is at this time a matter of conjecture. Obviously the coefficient m can be altered by other factors and would have to be determined for any batch of fruit to which the above relationship was to be applied. This could be done fairly quickly simply by determining green-life at two high temperatures, e.g. 86 and 96°F.

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The authors are officers of Horticulture Branch, Queensland Department of Primary Industries, and are stationed at the Sandy Trout Food Preservation Research Laboratory, Brisbane.