

# Measurement of banana green life

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## Measurement of banana green life.

**Abstract — Introduction.** This protocol aims at measuring the storage life potential of banana fruit, and at determining the physiological age of fruit. The principle, key advantages, starting plant material, time required and expected results are presented. **Materials and methods.** This part describes the required laboratory materials and the five steps necessary for calculating the banana green life duration, which corresponds to the number of days between the fruit harvest and climacteric crisis. **Results.** The measurement of O<sub>2</sub> and CO<sub>2</sub> concentrations allows one to detect the climacteric peak which marks the end of the banana green life.

France / *Musa sp.* / methods / fruits / measurement / maturity / storage

## Mesure de la vie verte de la banane.

**Résumé — Introduction.** Le protocole vise à mesurer la durée de stockage potentielle de la banane, et à déterminer l'âge physiologique du fruit. Le principe, les principaux avantages, le matériel végétal requis, le temps nécessaire aux mesures et les résultats escomptés sont présentés. **Matériel et méthodes.** Cette partie décrit le matériel de laboratoire requis et les cinq étapes nécessaires au calcul de la durée de la vie verte de la banane, qui correspond au nombre de jours entre la récolte du fruit et la crise climactérique. **Résultats.** La mesure des concentrations en O<sub>2</sub> et en CO<sub>2</sub> permet de détecter le pic climactérique qui marque la fin de la vie verte du fruit.

France / *Musa sp.* / méthode / fruits / mesure / maturité / stockage

## 1. Introduction

### Application

This protocol aims at measuring the storage life potential of banana fruit (fruit green life), and thus at determining the physiological age of fruit.

### Principle

Bananas are climacteric fruits with a ripening process divided into three distinct phases. The preclimacteric phase generally occurs just after harvest when the fruit is green and has a relatively low basal metabolism. The respiratory intensity of the fruit is quite low during this phase (10–20 mg

CO<sub>2</sub>·kg<sup>-1</sup>·h<sup>-1</sup>). When the climacteric rise is initiated, *i.e.*, ripening is triggered, the respiratory intensity increases five- to six-fold [1]. This corresponds to the climacteric peak. After this peak, the respiratory intensity drops again to 20–40 mg CO<sub>2</sub>·kg<sup>-1</sup>·h<sup>-1</sup>. The method described here is designed to detect the climacteric peak of a banana placed in a semi-permeable container, through an analysis of O<sub>2</sub> and CO<sub>2</sub> levels resulting from fruit respiration and the permeability of the plastic.

Key advantages. The method allows an accurate measurement ( $\pm 1$  day) of fruit green life; it is more reliable compared with the green life measurement method currently used and based on peel colour change and/or other related processes; it

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can be used to measure green life of fruits without risk of preclimacteric fruit being subjected to ethylene produced by other ripening fruit, because each fruit is placed in a semi-permeable container.

### Starting material

Freshly harvested green banana fruits are required for the protocol.

### Time required

Each gas measurement requires 2 min.

### Expected results

After 24 h of storage, O<sub>2</sub> and CO<sub>2</sub> levels should reach around 19.5% O<sub>2</sub> and 0.5% CO<sub>2</sub>, depending on the atmospheric volume of the open space of the bottle containing the fruit. At the onset of the climacteric rise, O<sub>2</sub> and CO<sub>2</sub> levels should be in the range of 16–17% for O<sub>2</sub> and 2–4% for CO<sub>2</sub> after 24 h of storage.

## 2. Materials and methods

### Laboratory materials

The protocol requires an O<sub>2</sub> and CO<sub>2</sub> analyser with a 50-mL plastic syringe; stretchable plastic film; 1.5-L plastic bottles cut off at the neck; a climatic room (regulated at 20 °C ± 0.5 °C); a thiabendazole solution at 500 ppm active ingredient.

### Protocol to measure the fruit green life

#### • Step 1

Choosing and cutting the fruit for analysis: choose a representative hand on a banana bunch to analyse (the middle hand of the bunch is generally selected); cut off a banana from the inner row (inner bananas are usually straighter and are easier to place in a 1.5-L plastic bottle).

#### • Step 2

Fruit treatment to hamper development of postharvest diseases: treat bananas with a postharvest fungicide.

To hamper the development of postharvest diseases such as anthracnose and crown rot that would shorten their green life [2], bananas are soaked for 2 min in a thiabendazole solution (500 ppm a.i.).

#### • Step 3

For fruit storage, place banana fruits in plastic bottles with the neck removed (one banana per bottle), and then seal bottles with a stretchable plastic film so that it sticks tightly to the bottle and secure it with elastic. Place the bottles in a climatic room (recommended temperature: 20 °C, *i.e.*, an average ambient temperature) for 24 h.

#### • Step 4

To measure O<sub>2</sub> and CO<sub>2</sub> concentrations:  
– after 24 h of storage, gently swirl the bottle containing banana to homogenise the atmosphere,  
– using the sampling syringe, take a gas sample through the plastic film for analysis,  
– repeat the analysis after 24 h. For that purpose, remove the stretchable plastic film for a few minutes in order to aerate the fruit, reseal the bottles with a new plastic film and put the [fruit / bottle] system in the climatic room for 24 h,  
– repeat the measurement every 24 h as long as O<sub>2</sub> and CO<sub>2</sub> concentrations remain constant in the range of 19.5% and 0.5%, respectively. O<sub>2</sub> and CO<sub>2</sub> measurements are stopped when a substantial change in these gas levels is noted (decrease from 19.5 to 16–17% for O<sub>2</sub> and increase from 0.5 to 2–4 % for CO<sub>2</sub>).

#### • Step 5

Calculate the fruit green life, which corresponds to the number of days between the fruit harvest and the last day of O<sub>2</sub> and CO<sub>2</sub> concentrations at 19.5% and 0.5%, respectively.

### Troubleshooting

If O<sub>2</sub> and CO<sub>2</sub> concentration measurements are close to values of the ambient atmosphere, it means that the stretchable film does not efficiently seal the bottleneck; therefore, check that the plastic film does not rip when stretched or that it is not punctured by a rough edge of the bottle; also check that the bottle is not punctured.

**Table I.**  
Measurement of the green life of the representative fruit of a banana bunch.

Date	Duration of green life (days after harvest)	Concentration (%)	
		O <sub>2</sub>	CO <sub>2</sub>
Harvest day	0	19.0	0.4
Storage; preclimacteric phase	1	18.9	0.5
	2	19.2	0.5
	3	19.0	0.6
	4	18.8	0.5
	5	19.1	0.5
	6	18.9	0.6
Storage: climacteric rise	7	16.5	3.8
Storage: postclimacteric phase	End of green life	12.1	8.0

### 3. Typical results obtained

The measurement of O<sub>2</sub> and CO<sub>2</sub> concentrations of the banana atmosphere allows the detection of the climacteric peak which marks the end of the banana green life (*table I*).

### References

- [1] Peacock B.C., Blake J.R., Some effects on non-damaging temperatures on the life and respiratory behaviour of bananas, Qld. J. Agric. Anim. Sci. 27 (1970) 147–168.
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