The effect of temperature on sweetpotato growth and development

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• Introduction

Sweet potato (*Ipomoea batatas* (L.) Lam.) is a tropical perennial crop cultivated as an annual in tropical, subtropical and temperate climates, in more than 100 countries around the world.

The crop will grow with temperatures between 15ºC and 35ºC; however, the lower and higher temperatures have detrimental effects on yield. This crop responds well to increasing moisture but it is also a drought-tolerant due to its deep roots. They grow best in a sandy loam, well-drained soil.

As temperature decreases, there is some temperature at which a plant stops developing. This temperature is called the "base temperature" and it varies from crop to crop.

• Objectives

To determine the base temperature for sweetpotato and to study the crop sensitivity to temperature.

• Materials and Methods

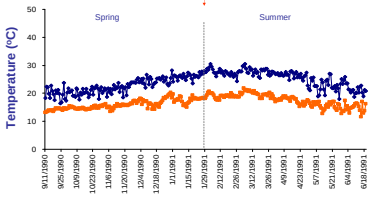
Four field experiments were conducted at two locations of the International Potato Center (CIP) in Peru during 1990 and 1991.

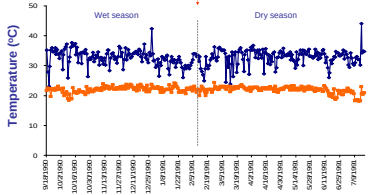
Each experiment consisted on a block with 100 sweetpotato plants, Jewel cultivar (25 rows, 0.2 m distance between plants, 0.9 m distance between rows). Non-destructive and destructive growth analyzes were performed every 7 and 21 days, respectively. Plant cover, fresh and dry weight of leaves, petioles, stems, fiber roots, storage roots, sweetpotatoes, number of leaves, stem length, and leaf area index were the parameters evaluated. Irrigation and fertilizers were applied according to each soil and plant requirements. A completely randomized factorial design was applied to this experiment.

• Location

Photo 1 shows study field at Lima: Lat 12º 04' 38.89"S, long. 76º 56' 54.04"W; 240 m.a.s.l., coastal area, desert-like conditions. Two cropping seasons tested: Spring (Sept 1990-Jan 1991); Summer (Jan-Jun. 1991)

Photo 2 shows study field at Yurimaguas: Lat 5º 54' 57.10"S, long. 76º 05'43.49"W; 180 m.a.s.l., humid rain forest. Two cropping seasons tested: Wet (Sept 1990-Feb 1991); Dry (Feb-Jul 1991)



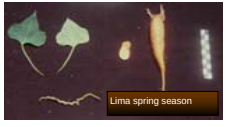


Maximum temperature — Minimum temperature

• Algorithm to determine base temperature: The least standard deviation method was used in this study (Yang et al., 1995):

$$x = \frac{\sum_{i=1}^{n} Tidi \sum_{i=1}^{n} di - n\sum_{i=1}^{n} di^2 Ti}{(\sum_{i=1}^{n} di)^2 - n\sum_{i=1}^{n} di^2}$$

Where x = base temperature, di = days, Ti = overall mean temperature of the ith planting, and n = number of plantings.



Photos 3 and 4: Sweetpotato variety 'Jewel' growing at Lima and Yurimaguas locations. Some differences can be appreciated at different parts of the plants.

• Results

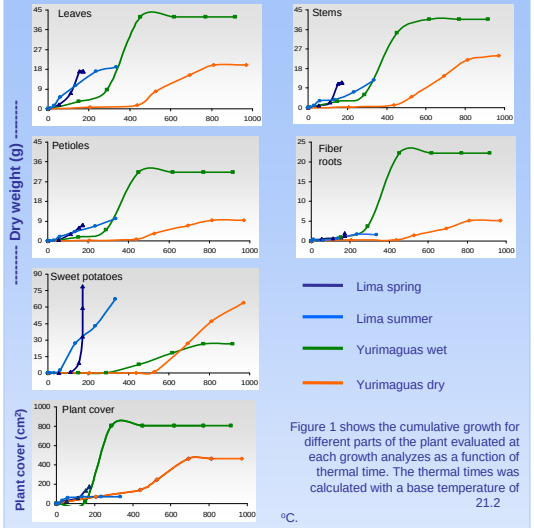


Figure 1 shows the cumulative growth for different parts of the plant evaluated at each growth analyzes as a function of thermal time. The thermal times was calculated with a base temperature of 21.2 ºC.

• Conclusions

- According to our results, base temperature for sweetpotato was 21.2 ºC.
- Averaged thermal time varied according to location and season: Lima spring (172 ºC); Lima summer (284 ºC); Yurimaguas wet (504ºC); and Yurimaguas dry (844ºC).
- Warmer and wet conditions promoted higher aerial biomass development and low sweetpotato yield (Yurimaguas wet); lower temperatures (Lima scenarios) or warmer conditions under irrigation only (Yurimaguas dry) promoted better storage roots production.

• Reference:

Yang, et al. 1995. Mathematical formulae for calculating the base temperature for growing degree days. Agricultural and Forest Meteorology 74:61-74