

ENVIRONMENTAL FACTORS AFFECTING TUBERIZATION

A.C. Posthumus*

SUMMARY

A review of literature of climatic and biotic factors affecting tuberization mainly of *Solanum* potatoes.

RESUME

Un aperçu des données sur les facteurs climatiques et biotiques sur la déterminisme de la tubérisation chez la pomme de terre et quelques autres cultures.

RESUMEN

Repaso de literatura de clima y factores bióticos patéticos la producción de tubérculos lo principal de *Solanum tuberosum*.

INTRODUCTION

Tuberization in plants showing this special morphogenetic feature does not take place at the same rate and intensity in different environments. Both climatic and edaphic and biotic factors, including pathogens, affect this phenomenon. The most important factors are photoperiod, temperature, light (intensity and quality), mineral nutrition, water availability and viruses.

The physical environmental factors act by the synthesis, destruction, transport and activation of growth substances. Minerals, water balance and viruses are also known to alter growth-substance balance in plants and hence environmental factors affecting tuberization may be at least partly explained by their influences on the growth substance. By affecting the intensity and duration of photosynthesis and respiration, the environment may also affect the level of photosynthate available for storage in tubers. According to one theory on the mechanism of tuberization, surplus photosynthate is required for the process.

Inductive and non-inductive environmental conditions have been distinguished. Kopetz and Steineck³⁵ claimed that differences in tuberization found between different cultivars may be explained by differences in critical daylength requirements defined as the daylength above which tuberization did not occur. However, perhaps it is better to distinguish favourable from unfavourable conditions, since it is now recognized that effects are apparently often quantitative not qualitative. Moreover, optimal environmental conditions differ for tuber initiation, growth and maturation and between different plant species and cultivars.

This paper will review knowledge collected mostly from temperate plant species, but in the expectation that such information may lead to a better understanding of tuberization in tropical species. However, there is danger in uncritical transfer of information from one species to another, or even from one cultivar to another within a species. The genetically determined tuber-forming potential of a plant, including the control of reaction to environment, is the most important factor in tuberization. Nevertheless, a knowledge and understanding of the influences of environmental factors may help to improve the yield and/or efficiency of cultivation of root and tuber crops in the tropics.

Tuberization has been reviewed in other crops by Courduroux, Dupaigne, Gregory and Jolivet^{14, 16, 24, 33}, but most work has been concerned with potatoes (*Solanum tuberosum* L.) only^{5, 41, 50, 59}.

EFFECTS OF PHOTOPERIOD

On potatoes

Garner and Allard²³ reported that tuberization in *Solanum* potato was promoted by short-day conditions. Although differences were later found between different cultivars of potato, the promotional effect of short days was confirmed.^{5, 65} Slater⁵⁷ took account of the differences in total radiation as well as the shortening of daylength. Driver and Hawkes¹⁵ demonstrated that many varieties of potato tuberize earlier in shorter than in longer days. Gregory^{25, 26}, Chapman⁹, Okazawa and Chapman⁴⁹, Madec⁴² and Purohit⁵⁴

*Centre for Plant Physiological Research, Bornesteeg, Wageningen, Holland.