Effects of Water Stress on Leaf Growth, Leaf Diffusive Resistance and Net Photosynthetic Rate in Snapbean (*Phaseolus vulgaris* L.)

Suh, Kye Hong and Joon Ho Kim
(Department of Botany, Seoul National University, Seoul)

강낭콩의 잎생장, 확산저항 및 토양습합이에 미치는 수분스트레스의 영향

徐 桂 弘 金 俊 鎮
(서울대학교 自然科學大學 植物學科)

**ABSTRACT**

Effects of water stress on leaf growth, leaf diffusive resistance and net photosynthetic rate were studied on the first trifoliate leaves of snapbean (*Phaseolus vulgaris* L.) grown under controlled environmental conditions in a growth cabinet. As the drying cycle progressed, leaf water potential, relative water content and the net photosynthetic rate were decreased, but the leaf diffusive resistance was increased. Leaf growth in the elongation and the area was the most sensitive, but the net photosynthetic rate was the least sensitive to water stress. The grade of the leaf diffusive resistance after recovery was not affected by the different degrees of water stress experienced during the drying cycle but the recovering time attained to the control level was delayed. The leaf diffusive resistance was not affected at leaf water potential above −8 bars, but increased rapidly below that value.

**INTRODUCTION**

There have often been considerable damages for plant growth owing to water deficit during May and June, when plants grow vigorously, in Korea. Vast numbers of data demonstrating effects of water stress on the plant growth and production have been accumulating (Hsiao, 1973).

Plants adjust themselves to water deficit in various ways. Since Pfeffer (1900) knew that photosynthesis is reduced in wilted leaves and attributed the inhibition to stomatal closure, the progress was made in photosynthetic research on plants subjected to water deficit. Boyer (1976) pointed out that (1) photosynthesis by plant is inhibited as water
deficit become severe, (2) part of the photosynthetic limitation may be caused by reduction in leaf growth or by senescence of leaves, and (3) part may be caused by inhibition of the photosynthetic activity of existing leaves.

It apparently seems that drought-induced reduction in photosynthesis not only decrease the total dry matter accumulated by plants (Stoker, 1974; O'Toole, 1975), but it also appear to be a major limitation for production of the edible parts. Recent works that measured photosynthesis as a function of leaf water status have confirmed the inhibition of the process (El-Sharkawy and Hesketh, 1964; Boyer, 1970; Bazzaz et al., 1972; Boyer and Potter, 1973). The relationship between photosynthesis and leaf growth under water stress has been studied by many investigators (Boyer, 1968, 1970; Acevedo et al., 1971; Brandle et al., 1977; Sharp and Davies, 1979).

Leaf elongation during the water stress has been also studied (Boyer, 1968; Acevedo et al., 1971; Gander and Tanner, 1976; Sivakumar and Shaw, 1978). Leaf enlargement in sunflower leaves is reduced at a water potential as high as -2.5 bars and stops at -4 bars (Boyer, 1668), and in Solanum tuberosum, at -5 bars (Gander and Tanner, 1976). The authors came to the conclusion that leaf growth was a sensitive parameter of water stress compared to net photosynthetic rate.

The present investigation is focused on the accurate analysis of the relationships of water status in leaves to leaf diffusive resistance, leaf growth or net photosynthetic rate in snapbean during the vegetative stage grown in a controlled environment at various levels of water stress.

MATERIAL AND METHODS

Plant material. Snapbean (Phaseolus vulgaris L. Pole fadenlosa) was used as plant material. The seeds were sterilized with 1% sodium hypochlorite solution for 20 min and soaked in water at 26°C for 3 days. Five germinated seeds with about 2 cm long root were planted into a 1/50,000 a Wagner pot filled with 2.8 kg of dried soil mixture (2:1 v/v of loam: humus). At the 11th day after planting when the plants were completely germinated, the seedlings were thinned and 3 plants were retained per pot. The pots were fertilized once with 1.5 g urea, 1.5 g KCl and 1.0 g calciumed phosphate per pot at the 11th day after planting.

The material plants were grown in a growth cabinet (Yanaco YGC-250L/CO2) in which the environmental conditions were: 14 hr photoperiod, 27/17°C of air temperature, 60/80 % relative humidity, and 0.5 m/sec of wind speed. The total light intensity was 270 watt/m² at the level of the leaves. The position of pots was changed in turn every day in order to make the homogeneous growth condition.

The potted plants were divided into 4 groups: 1) control plot which was continuously watered, 2) S-1 plot which experienced light water stress to stop watering until the