

B1 Growth and Photosynthetic Responses of Dwarf Apple (*Malus domestica* Borkh. cv. Fuji') Saplings after Three Years of Exposure to Elevated Atmospheric Carbon Dioxide Concentration and Temperature

NHRI: H.M. RO*, I.B. LEE; NICEM: P.G. KIM; NAAES: M.S. YIEM

**상승 CO₂ 농도 및 기온에 3년 동안 노출된 왜성 사과나무의
생육 및 광합성 특성**

원예연구소: 노희명*, 이인복; 서울대학교: 김판기; 고령지시시험장: 임명순

Objectives

We measured growth responses of dwarf apple saplings during three years of exposure of two levels of each of atmospheric CO₂ and temperature pattern. To analyze the differences in growth responses due to temperature, CO₂ concentration and their interaction, leaf photosynthetic responses of trees were measured.

Materials and Methods

- Duration: 1998 - 2000
- Material: Dwarf apple (*Malus domestica* Borkh.) cv. 'Fuji' saplings
- Binary combinations of two levels of each:
 - CO₂ concentration (C_a): 360 (control) and 650 (elevated) $\mu\text{mol CO}_2 \text{ mol}^{-1}$
 - Air temperature: ambient and 5°C above ambient pattern

Results and Discussion

Overall tree growth was suppressed at elevated C_a alone, but the suppression was ameliorated with warmer temperature. Neither temperature nor C_a affected leaf chlorophyll content and stomatal density. Elevated C_a decreased mean leaf area, but increased starch accumulation, thus resulting in higher specific dry mass in leaves. Starch accumulation was reduced due to warmer temperature. Under predicted future C_a, the suppressed light-saturated rates of leaf photosynthesis due to elevated C_a were removed or enhanced with warmer temperatures compared to control values. Elevated C_a increased optimum temperature for photosynthesis by ca. 4°C, while warmer temperature did not. The result of this study suggested that long-term adaptation of apple saplings to growth at elevated C_a may be associated with a potential for increased growth and productivity, if a doubling of C_a causes an increase in atmospheric temperature by 5°C.

연락처 전화: 031-240-3716 E-mail: hmro@unitel.co.kr

Table 1. Effects of atmospheric temperature and CO₂ concentration on tree width and height, shoot length, numbers of shoots and leaves, and fruit yield.

Temp.	CO ₂ concentration (μmol mol ⁻¹)	Tree width (cm)	Tree height (cm)	Shoot length (cm)	Number of shoots	Number of leaves	Mean leaf area (cm ²)	Fruit yield (kg)
Year 1 (1998)								
Ambient	360	127.3	205.5	287.7	23	549	26.7	NA
	650	126.8	159.5	180.3	20	382	23.9	NA
Ambient +5°C	360	129.5	205.8	446.0	21	604	31.7	NA
	650	134.8	216.0	808.6	26	830	36.3	NA
Year 2 (1999)								
Ambient	360	157.5	235.1	1467.9	44	457	33.2	4279
	650	153.3	223.7	1129.9	32	458	26.2	807
Ambient +5°C	360	154.7	239.9	1901.5	40	430	35.5	1750
	650	163.8	280.2	3144.0	74	512	37.7	2180
Year 3 (2000)								
Ambient	360	210.8	268.9	1793.3	39	1314	42.0	5975
	650	187.4	273.4	1229.8	34	865	29.8	2026
Ambient +5°C	360	224.8	276.4	1667.7	43	1082	42.0	5037
	650	236.0	332.0	1961.7	50	1384	38.9	6498

ANOVA of contrast variables

Year								
Linear		***	***	***	***	***	***	NA
Quadratic		**	n.s.	***	***	***	n.s.	NA