

Harvest Index of 'Rocky' cucumber (*Cucumis sativus* L.) plants grown in 2000 ppm CO₂ is not different from 'Rocky' cucumber grown in 400 ppm CO₂

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Abstract

Cucumber cultivars vary in growth habit, pollination requirements, flower production, fruit type and preparation methods. Greenhouse trials were conducted at Texas Tech University to screen cucumber cultivars for parthenocarpic, gynoecism, compact vines, and fruit load. Candidate cultivars screened were; 'Alibi', 'Amour', 'Cucumber Bush', 'Diva', 'Genuine', 'H-19 Little Leaf', 'Marketmore 76', 'Rocky', 'Socrates', and 'Tyria'. Of these, 'Rocky' was chosen for Environmental Growth Chamber trials because it is a gynoecious, parthenocarpic pickler type that produces a consistent high fruit set. Plants were grown hydroponically in an EGC at 16h light/8h dark, 24°/20°C, 75/99% relative humidity, ~650 µmol/m²/sec, and 400 or 2000 ppm CO₂. Leaf area, fruit and plant weight, and harvest index data were quantified. Fruit of 3½-5 inches were harvested weekly (Figure 1). Leaf area was measured by removing leaves from the 10th and 20th nodes and quantifying with a LI-3100 Leaf Area Meter. At the termination of the experiment plants were harvested and weighed. Data was analyzed using the Mann-Whitney t-test (P=0.05). Leaf area and total fruit weight of plants grown in 400 ppm CO₂ was significantly different than those grown in 2000 ppm CO₂. Weight of plants grown in 400 ppm CO₂ was significantly different than weight of plants grown in 2000 ppm CO₂. Harvest indices of plants grown in 400 ppm CO₂ were not significantly different than plants grown in 2000 ppm CO₂.

Introduction

Cucumber is a candidate vegetable for growth in a closed ecological life support system (Gitelson and Okladnikov, 1994). Gynoecious, parthenocarpic cultivars are especially suited for space production because they produce high edible (fruit) biomass without the need for pollination. 'Rocky', a gynoecious and parthenocarpic cucumber cultivar, was grown at 400 and 2000 ppm CO₂ to evaluate the effect of CO₂ on biomass and fruit production.

Materials and Method

Greenhouse trials were conducted at Texas Tech University Horticultural complex to identify a suitable cucumber cultivar for growth in an EGC. Ten cultivars were chosen for screening based on criteria pertinent for cucumbers grown in controlled environments. These criteria include parthenocarpic, gynoecism, compact vines, and high fruit load. Of the 10 cultivars, 'Rocky' was chosen because it is an early, parthenocarpic, gynoecious cultivar that consistently produces small fruit (4") throughout the growing season. 'Rocky' also exhibited a high harvest index. Three 'Rocky' seed were sown in an EGC at 400 or 2000 ppm CO₂ in an area 1x1 m². Plants were grown in recirculating Hydrosol (5-11-26) solution at 16 hour light/ 8 hour dark photoperiod, 24°/20° C, 75/99 %RH, ~650 µmoles/m²/sec. Fruit of 3½-5 inches was harvested and weighed weekly. Leaves were removed from the 10th and 20th nodes of plants grown in 400 and 2000 ppm CO₂. A LI-3100 Leaf Area Meter was used to quantify leaf area (cm²). Leaves grown in 400 ppm CO₂ were smaller than leaves grown at 2000 ppm CO₂. At the termination of the experiment plants were harvested and weighed (Figure 2). Harvest index was calculated as edible to total (edible + non-edible) biomass. Data was analyzed using the Mann-Whitney t-test (P=0.05).



Figure 1. 'Rocky' cucumber fruit grown in an EGC at 2000 ppm CO₂.



Figure 2. 'Rocky' cucumber plants grown in an EGC at 2000 ppm CO₂ one week before termination of experiment.

Results

At harvests 1 and 2, a higher average number of 'Rocky' cucumber were harvested at 2000 ppm CO₂ than at 400 ppm CO₂ (Figure 3). There was no difference in the average number of cucumbers harvested at harvests 3 through 5 in 400 vs. 2000 ppm CO₂. By harvest 6, the average number of cucumbers harvested in 400 ppm CO₂ was greater than those harvested at 2000 ppm CO₂. Leaf area, and plant and fruit weight grown in 2000 ppm CO₂ were significantly higher when compared to plants grown in 400 ppm CO₂ (Table 1). The harvest indices of plants grown in 400 and 2000 ppm CO₂ were not different. This research suggests that edible and non-edible biomass production increased proportionately for 'Rocky' cucumber plants grown in an EGC at 2000 ppm CO₂.

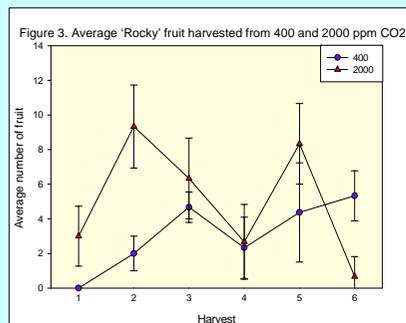


Table 1. Harvest index, total leaf area (cm²), plant and fruit weight (g) of 'Rocky' cucumber plants grown in an EGC at 400 and 2000 ppm CO₂.

	400	2000
Leaf Area (cm ²)	1464 b	2584 a
Plant Weight (g)	982 b	1961 a
Fruit Weight (g)	5194 b	8238 a
Harvest Index	0.84 a	0.79 a

Summary

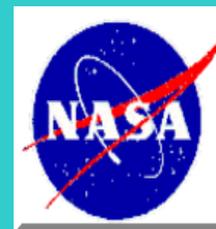
- Harvest Index of 'Rocky' plants grown in 400 ppm CO₂ was not different than 'Rocky' plants grown in 2000 ppm CO₂.
- Leaf area of plants grown in 2000 ppm CO₂ was larger than leaf area of plants grown at 400 ppm CO₂.
- Plant and fruit weight of plants grown in 2000 ppm CO₂ were higher than plants grown at 400 ppm CO₂.
- Average number of fruit harvested from 2000 ppm CO₂ was higher than 400 ppm CO₂ at the beginning of the experiment; however, at the end of the experiment the average number of fruit harvested from 400 ppm CO₂ was greater than average number of fruit harvested from 2000 ppm CO₂.

Literature Review

Gitelson, J.I., Y.N. Okladnikov, 1994 Man as a component of a closed ecological life support system. 1:73-81.



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