

Lack of chilling resistance in *Cucumis sativus* var. *hardwickii* (R.) Alef.

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Improvement of cucumber (*Cucumis sativus* var. *sativus* L.; hereafter referred to as *sativus*) for low temperature germination and emergence ability has been the focus of several research programs in the U. S. A. (1, 3, 4). In contrast, screening and selection of cultivars for resistance to chilling injury after emergence has not been reported in the U. S. A. However, selection for growth of slicing cucumbers under conditions of cool temperatures (20°C day and 15°C night) and low light has been successful in Europe (2).

*C. sativus* var. *hardwickii* (R.) Alef. (hereafter referred to as *hardwickii*) is a progenitor or wild relative of *sativus* and was originally collected in the foothills of the Himalaya mountains. It is a potential source for increased yield in *sativus*. Because of its origin, *hardwickii* may be a good source for chilling resistance. Therefore, three experiments were designed in order to measure: 1) The effects of leaf handling on the measurement of photosynthesis rate and stomatal conductance and; 2) The ability of *hardwickii* and *sativus* to recover from exposure to chilling.

*Experiment 1.* *Sativus* (WI 1606; gynococious) and *hardwickii* (PI 215589; monoecious) plants were grown in 100-mm-diameter pots containing Promix in two controlled-environment chambers at 30°C under a 16 hour photoperiod (at 300  $\mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$ ) in a randomized complete block design with 3 replications. At the 6-leaf stage, plants in both chambers were subjected to 5°C for 24 hours (at 300  $\mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$ ) and returned to 30°C. The photosynthesis rate (PR) and stomatal conductance (SC) of the 2<sup>nd</sup> through 4<sup>th</sup> leaves (leaf 0 was the cotyledon) of plants in one chamber were measured using a portable photosynthesis system (LI-6000 Li-Cor Inc., Lincoln, Nebraska) 2, 3, and 6 days after exposure. Plants in the second chamber were measured on day 6 after exposure. Analyses of variances were performed on measurements taken on day 6 after exposure.

*Experiment 2.* *Sativus* and *hardwickii* plants were grown as described in experiment 1. At the 6 leaf stage, the PR and SC of plants in one chamber was measured as previously described and then plants were exposed to 5°C for 24 hours, returned to 30°C and measured again after 2 days. In a second chamber, plants were measured only once 2 days after chilling exposure. Analysis of variance was performed on measurements taken 2 days after exposure.

*Experiment 3.* *Sativus* and *hardwickii* plants were grown as previously described. At the 6-leaf stage, plants in one chamber were exposed to 5°C for 24 hours, returned to 30°C, and measured for PR and SC 6 days after chilling as described above. Plants in a second chamber were grown continuously at 30°C, and PR and SC measurements were taken immediately following those which had received chilling exposure. Plants were harvested and measured for leaf area, stem and leaf dry weight, and numbers of lateral branches and leaves. Analysis of variance was performed on PH and SC measurements taken 6 days after exposure and on morphometric characters.

Experiment 1 assessed the effect of handling and measurement of plants after exposure to 5°C. No significant difference in PR and SC could be detected among plants measured several times and those measured only once suggesting that handling does not affect subsequent measurements of these plants (Figure 1). Significant differences in PR were recorded between *sativus* and *hardwickii*, but not for SC. Regardless of treatment, the *sativus* inbred always had a higher PR when compared to *hardwickii*. However, only when plants were measured 3 times did the *sativus* inbred have higher SC rates.

Experiment 2 assessed the effect of handling and measurement before and after chilling. Although there was no significant difference in the PR and SC rates of plants due to handling and measurement, the PR and SC rates of the *sativus* inbred was always higher than *hardwickii* (Figure 1). A closer inspection of the reaction of individual leaves suggested that when plants were measured before chilling, the results were inconsistent. At some leaf positions this response was elicited, while in others it was not. These inconsistent responses among leaves were not observed when plants were measured only once.

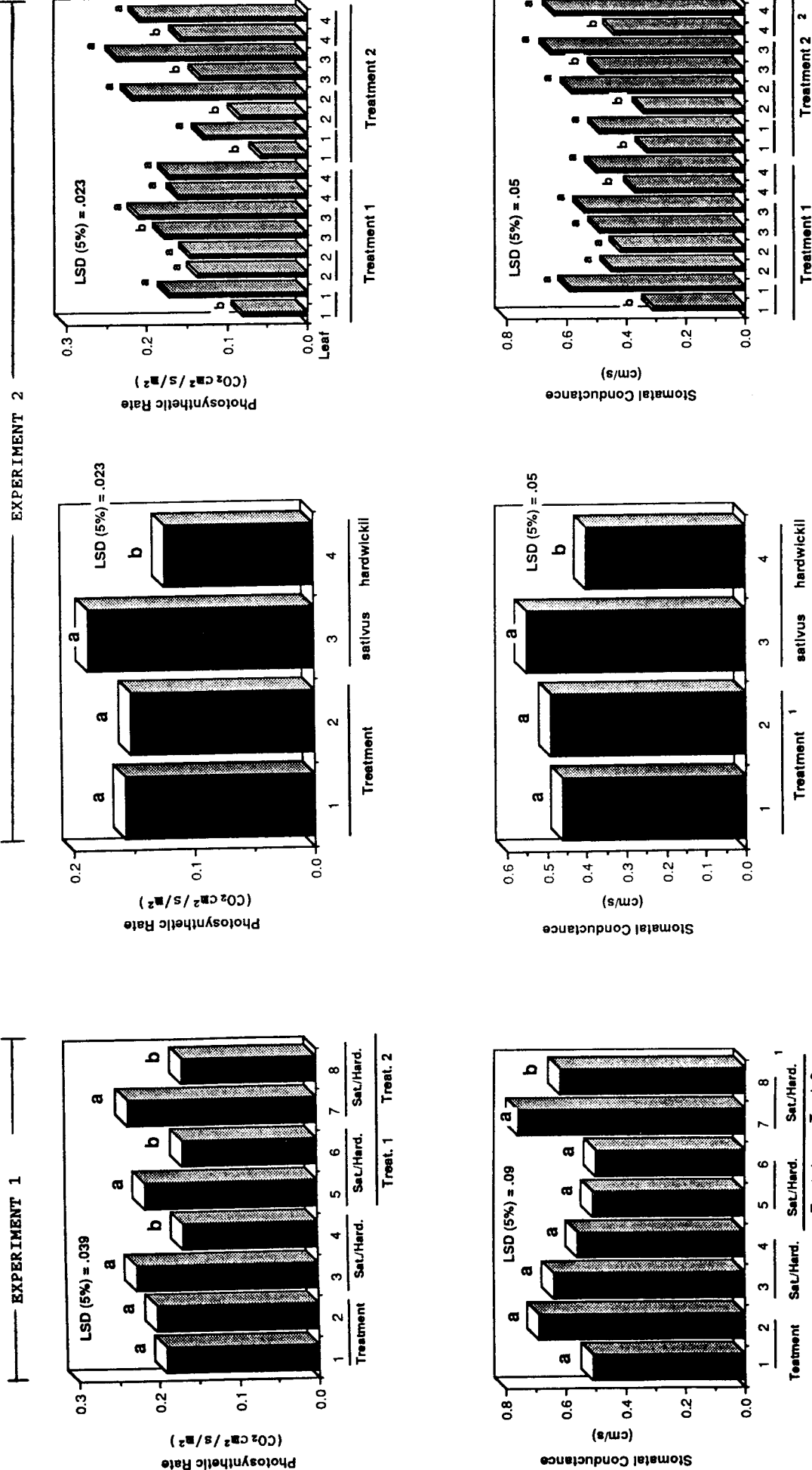
Experiments 1 and 2 indicated that handling and measurement before or after chilling exposure did not significantly affect PR or SC and, therefore, the interpretation of effects for these response variables. Experiment 3 indicated that, although chilling significantly lowers PH and increases SC (Figure 2), *sativus* consistently had higher PR and SC rates when compared to *hardwickii* regardless of treatment. A reduction in leaf area (54%), stem dry weight (52%), leaf dry weight (61%), lateral branch number (76%), and leaf number (59%) was recorded in plants exposed to chilling temperatures (data not shown).

The fact that *hardwickii* stomates are apparently open to a lesser degree (lower SC rates) when compared to *sativus* may provide an explanation to the increased chilling injury of *hardwickii*. An hypothesis that explains the data is that *hardwickii* and *sativus* transpiration/photosynthesis ratios may be relatively equal, and stomatal response to low temperatures may be slower in *hardwickii* than in *sativus* making it more sensitive to chilling and affecting the recovery time.

#### Literature Cited

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TABLE 1. Response of photosynthetic rate and stomatal conductance in *Cucumis sativus* var. *sativus* L. (WI 1606) and var. *hardwickii* (R.) Alef. (PI 215589) to 5°C in two experiments. Experiment 1 assesses the effect of handling and measurements of plants after chilling period. Experiment 2 compares plants grown under continuous 30°C to those measured before and after exposure to 5°C for 24 hrs and then returned to 30°C.

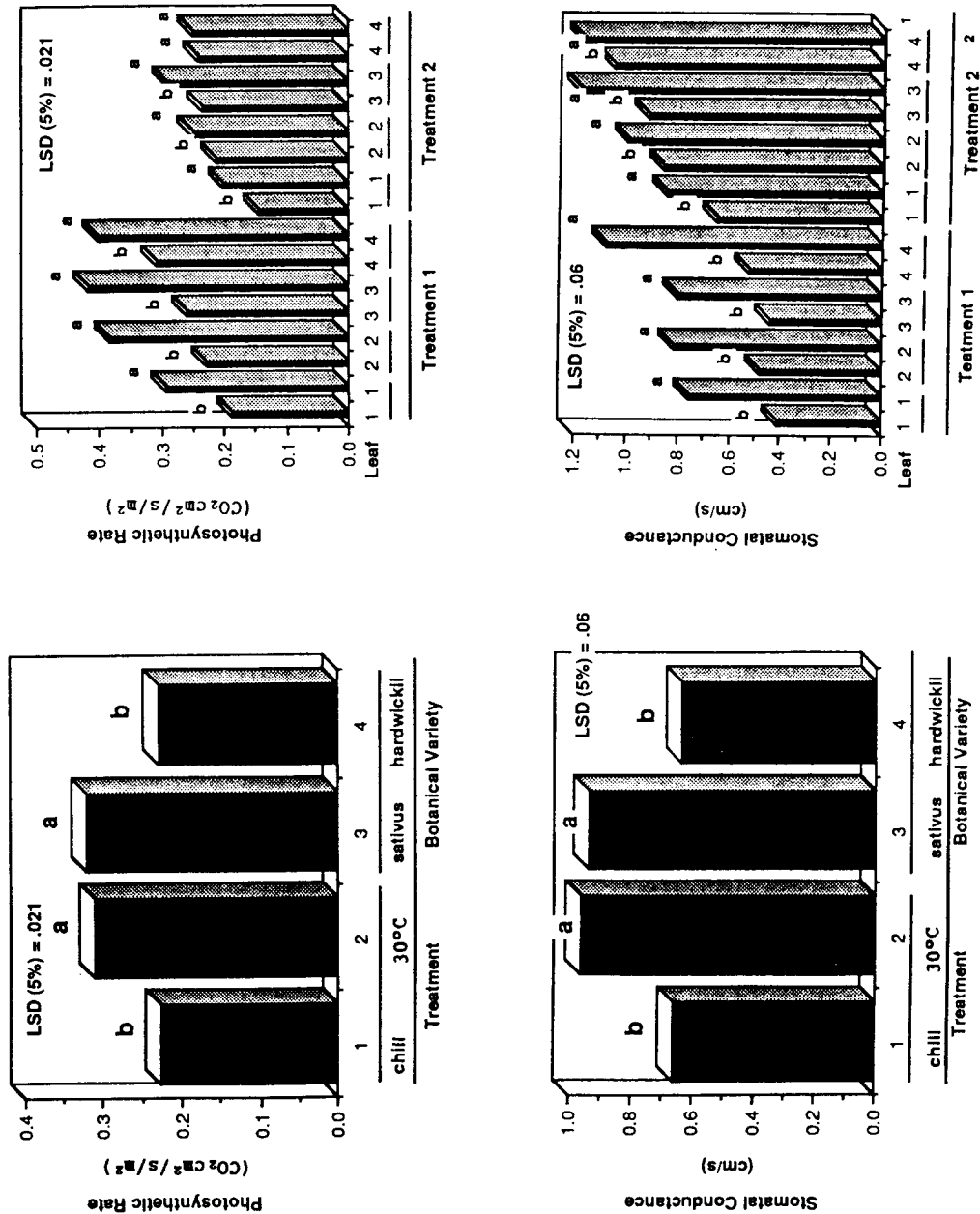


1-First bar in each series represents *hardwickii*, second *sativus* for each leaf.  
 2-Treatment measurements taken at random on a particular plant.

1-Treatment 1=Plants grown at 30°C, measurements taken, then chilled (5°C) for 24 hrs, then returned to 30°C & measured after 2 days. Treatment 2=Same as Treatment 1 except no measurements taken before chilling.

1-Treatment 1=Plants grown at 30°C then chilled (5°C) for 24 hrs, then return to 30 and measurements taken after 6 days. Treatment 2=Same as Treatment 1 except measurements taken 2, 3, 5, 6 days

Table 2. Response of photosynthetic rate and stomatal conductance in *Cucumis sativus* var. *sativus* L. (WI 1606) and var. *hardwickii* (PI 215589) to chilling (5°C) in Experiment 3.



<sup>1</sup> First bar in each series represents *hardwickii*, second *sativus* for each leaf.

<sup>2</sup> Treatment 2=Plants grown continuously at 30°C; Treatment 1=Plants grown at 30°C, then chilled (5°C) for 24 hrs, then returned to 30°C and measured after 6 days.