between the performance of sister lines and those with one common parent. For example, 73B685 is a sister line to 'Merit', and 73B677, 73B675, and 73B678 have as one of their parents the line from which 'Merit' and 73B685 were selected. The % of fruit set for these 5 lines ranged from 77 to 63%. Another example of lines with one common parent that yielded similar results was 73B681 and 73B692, with 67 and 54% fruit set. A third example was 73B689, 73B692, and 73B691, which have one common parent and which had fruit sets of 50, 47, and 45%.

Lack of precise controls prevented the study of day verses night temp on fruit set. According to P.W. Leeper (personal communication), high humidity may also prevent pollen from being shed from certain lines but our procedure did not allow us to make such observations because only those flowers from which we saw pollen shed were tagged. Under the conditions of the test, natural fruit set, without the use of the vibrator, was less than 10% for each of the tomato lines.

Our study did not take into account the effect of the temp of the days that preceded or followed pollination on fruit set. However, because the greenhouse was consistently hot (max day range, 26° - 37°C) during the test, and flowers from each line were pollinated on each of the 12 days, temp variation should not have affected the comparisons made on Table 2.

We believe that the technique of using a greenhouse for screening for high temp setting ability can be useful in an applied tomato breeding program. Our results suggest that meaningful differences among lines or cultivars can be detected and that relative fruit setting ability in the field is paralleled in the hot greenhouse. When conducting a greenhouse screening, we suggest the inclusion of standard cultivars such as Chico III, Merit, C28, and Red Rock.

**Literature Cited**


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**Wilting and Damage to Cucumber by Spotted and Striped Cucumber Beetles**

Robert L. Haynes and C. M. Jones

**Abstract.** Spotted and striped cucumber beetles (Diabrotica undecimpunctata howardi Barber and Acalymma vittata Fab., respectively) caused significantly more damage to bitter cucumber (Cucumis sativus L.) wilted by drought or infection by Erwinia tracheiphila E.F.S.-Holland than to bitter non-wilted or non-bitter wilted and non-wilted plants. Bitter wilted plants had significantly more cucurbitacin than did bitter non-wilted material.

Cucurbitacins are bitter secondary plant substances that occur widely in wild and cultivated Cucurbitaceae. Cucurbitacins are tetracyclic triterpenoids with molecular weights ranging from 520 to 574. Fourteen cucurbitacins have been found and many of them have been chemically characterized (6, 8). They appear in plants as glycosides or aglycones. Cucurbitacins B and E are believed to be primary cucurbitacins from which other cucurbitacins are derived by metabolic processes during different stages of plant development (7).

In the Cucurbitaceae bitterness in the fruit is conferred by a single dominant gene (1). Cucumber cultivars can be separated into 3 classes on the basis of which plant part contains cucurbitacin: (a) bitter vegetative parts and non-bitter fruit that may turn bitter under unfavorable growing conditions, (b) bitter vegetative parts but non-bitter fruits under all conditions, and (c) non-bitter fruit and vegetative parts.

Cucurbitacins have been shown to attract some insects (2, 4, 10) and repel others (2, 3). Chambliss and Jones (2, 3) and DaCosta and Jones (5) speculate that cucurbitacins evolved as protective mechanisms against feeding by insect pests, but some species evolved the ability to utilize these compounds as chemical attractants.

**Wild induction.** Cucumber plants were wilted by 2 methods. Five-day old bitter and non-bitter seedlings of 'Tablegreen 65' and 'Marketmore 70' cucumber were grown in sterilized soil and inoculated with E. tracheiphila according to the multi-needle puncture technique proposed by Prend and John (9). Symptoms of the disease were observed after 5-6 days in the greenhouse.

Five day old seedlings of the same cultivars grown in 4-inch clay pots in sterilized soil were also wilted by withholding water for 24 hr after initial wilting symptoms appeared.

Bitter and non-bitter 8-day old seedlings wilted either through E. tracheiphila infection or drought and matched by size, age, and degree of wilting were compared to similar non-wilted ones in 1.3 x 2.7 m rectangular cages containing cucumber beetles. The cages were constructed of one-half inch plywood with a glass top and the sides and back were made of organdy cloth. Cages either contained pure stands (bitter or non-bitter wilted and non-wilted seedlings in separate cages) or mixed stands (bitter and non-bitter wilted and non-wilted seedlings in the same cage). Spotted and striped cucumber beetles in separate cages were used as test organisms.

Cages with a pure stand containing 100 beetles and 40 seedlings and those with a mixed stand containing 200 beetles and 80 seedlings were allowed to remain in the greenhouse without any supplemental lighting for 72 hr. The greenhouse ranged from 21.1 to 27.7°C. The seedlings were scored after 72 hr on a 0-3 scale, (0 = no feeding injury; 1 = slight; 2 = intermediate; and 3 = severe).

**Purification, separation, and determination of the quantity and quality of cucurbitacins.** A 10 g dry wt sample each of bacterial wilted, drought-induced wilted, and non-wilted 'Marketmore 70' and 'Tablegreen 65' cucumber plants (Bi-) were placed for 1 min in a Waring Blender with 20 ml of ethanol. The homogenate was filtered and 20 ml of concd lead acetate added. After centrifuging for 10 min at 2500 rpm, 20 ml of potassium hydrogen phosphate (monobasic) were added and an additional centrifugation carried out. To this ethanolic layer, 20 ml of petroleum ether were added and shaken 3 times. Free amino acids and other impurities were in this ether layer and were discarded. To extract cucurbitacins
from the ethanolic layer, 20 ml of chloroform were added and the layer shaken 3 times. The chloroform layer containing the cucurbitacins was washed twice with equal amounts of distilled and deionized water. The chloroform fraction was evaporated over sodium sulfate to about 0.5 ml and this material was placed on fluorescent silica gel GF245 TLC plates and developed with a chloroform:methanol solvent system (95:5 v/v). Pure cucurbitacins were chromatographed at the same time in order to determine the kinds of cucurbitacins present in the wilted and non-wilted plants.

Cucurbitacins were detected by non-fluorescent spots against a fluorescent background under short wave UV light (2,540 A). The spots were eluted from the TLC plate with a chloroform: methanol: water. The chloroform layer was placed on a TLC plate, and developed with a chloroform:methanol solvent system (95:5 v/v). Pure cucurbitacins were chromatographed at the same time in order to determine the kinds of cucurbitacins present in the wilted and non-wilted plants.

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Bitter cucumbers of both cultivars wilted by E. tracheiphila or drought contained a significantly greater quantity of cucurbitacin than bitter non-wilted material on a dry wt basis (Table 2).

The cotyledons of 8-day old wilted and non-wilted bitter cucumber seedlings had only cucurbitacin C. The significantly greater damage caused by spotted and striped cucumber beetles to bitter wilted cucumber seedlings was due to a greater quantity of cucurbitacin C rather than to a qualitative change in cucurbitacin content.

These results suggest that the effect of wilting on cucumber beetle damage is due to the increased production of cucurbitacin and possibly other factors. Thus, cultural methods to prevent stress may also prevent insect injury.

### Literature Cited