

Peroxidases in Dwarf and Determinate Cucumbers¹

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Abstract. Variation in peroxidases due to age and locus in the plant greatly exceeded variation due to growth habit genotype in cucumber (*Cucumis sativus* L.).

One reason the genetics of growth-habit in cucumbers have been difficult to study is that environmental effects are often greater than genetic effects. To circumvent this problem, it was hypothesized that peroxidases are associated (perhaps causal) with the expression of growth habits, and therefore might serve as biochemical genetic markers, which would not be so vulnerable to environmental modification.

This hypothesis has supportive evidence. Some peroxidases catalyze the oxidation of IAA (indoleacetic acid), which Sandhu et al. (10) reported to be the controlling hormone in cucumber stem elongation. Secondly, Loy (8) reported measurable differences in peroxidase activity between bush and vine-type squash. Lastly, preliminary work in our laboratory indicated that determinate cucumbers showed a marked increase in leaf peroxidase activity at the time of termination.

Ten cucumber lines were studied including standard cultivars, and several dwarf and determinate lines (Table 1). In the first 3 of 4 experiments above-ground portions of greenhouse-cultivated seedlings were subjected to electrophoretic analysis. In the last experiment cucumber seedlings aged 2, 4, 6, 8, 10, and 12 days, were used for peroxidase analysis. Three seedlings, including roots, in the 2 and 4 day old groups and 2 seedlings in the remaining groups were pooled together as the sample from which peroxidases were extracted and electrophoresed. Con-

current experiments were conducted to assess the organ specificity and effect of age on peroxidase banding patterns in selected individuals.

The tissues were weighed, then ground at room temperature in 2 volumes of extraction solution (0.5 M NaCl, 0.02 M K-phosphate buffer pH 6.8, 0.1% Triton X-100, 0.4 mM EDTA). After centrifugation the supernatant was diluted 1:5 with 20% sucrose solution and applied to gels in each of 2 electrophoretic systems; an anionic system derived from Davis (1), and a cationic system derived from Williams et al. (11). At the end of the electrophoretic run, gels were removed and incubated in a peroxidase staining solution of benzidine - H₂O₂ (7) until bright blue bands appeared. Quantitative estimates of peroxidase activity were made (5) with quaiacol as the hydrogen donor. Details of the experimental procedures were reported elsewhere (9).

The peroxidase banding pattern of greenhouse-cultivated cucumber seedlings showed no characteristics that could distinguish either dwarf or determinate lines from standard cultivars. In the fourth experiment peroxidase band-

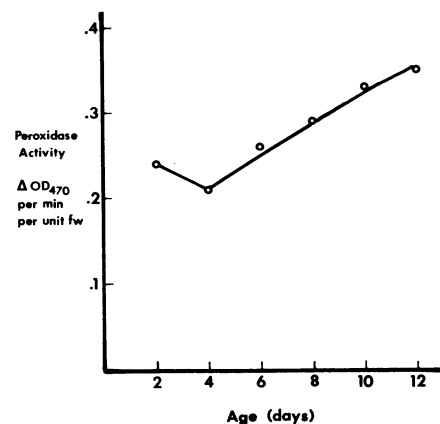


Fig. 2. Effect of age on peroxidase activity of developing cucumber seedlings as estimated with guaiacol - H₂O₂ assay. The plot represents the average of all 10 lines, since there were no significant differences among lines.

ing patterns of cucumber seedlings were monitored over a period of time when dwarfness was expressed; i.e., hypocotyl lengths of dwarf lines were shorter than other lines. Roots were included so that the sample contained peroxidases from all parts of the plant. Again, no growth-habit specific banding patterns were observed (Fig. 1).

The diagrammatic banding patterns (Fig. 1) were derived from critical examination of 12 gels for each genotype (aged 2 through 12 days). To increase band separation, the electrophoretic fronts were permitted to migrate out the bottoms of the gels. Consequently, R_f values were not calculated and the indicated reference bands were used to standardize the migration distances. The apparent differences, which were not judged reliable, occurred as very faint bands or bands which were very close together.

Quantitative estimates of peroxidase

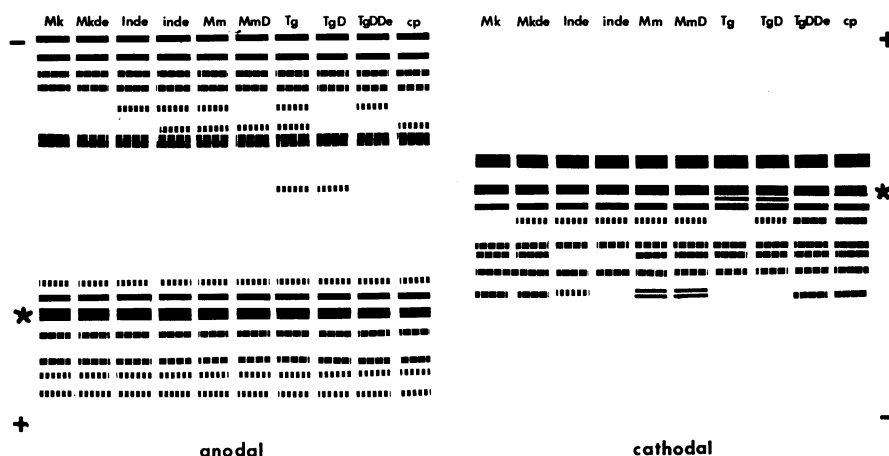


Fig. 1. Peroxidase banding patterns of cucumber seedlings derived from examination of 12 gels for each genotype, aged 2 through 12 days. Any band which occurred in at least 1 gel was recorded. In lieu of R_f values, migration distances were standardized to the indicated reference band (*). See Table 1 for definitions of genotype abbreviations.

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Table 1. Descriptions and sources of cucumber growth habits used in peroxidase study.

Abbreviations used in text	Growth habit description	Reported genotype	Source and comments
Mk	standard 'Marketer'	De/De	O. Shifriss — selfed at least 20 times
Mm	standard 'Marketmore'	De/De	W. L. George, Jr. — from Harris Seed Co. then selfed at least 9 times
Tg	standard 'Tablegreen 65'	De/De	W. L. George, Jr. — from Harris Seed Co. then selfed at least 9 times
Mkde	determinate 'Marketer'	de/de	W. L. George, Jr. — derived from backcrossing <i>de</i> of line 541 into 'Marketer'
Inde	determinate with intensifier	de/de, In-de/In-de	W. L. George, Jr. — derived from line 541 (3,4)
inde	determinate without intensifier	de/de, in-de/in-de	W. L. George, Jr. — derived from line 541 (3,4)
MmD	dwarf, determinate 'Marketmore'	—	H. M. Munger, Cornell University — derived from Hardin's PG-57 (2)
TgD	dwarf, determinate 'Tablegreen'	—	H. M. Munger, Cornell University — derived from Hardin's PG-57 (2)
TgDDe	dwarf, indeterminate 'Tablegreen'	—	H. M. Munger, Cornell University — derived from Hardin's PG-57 (2)
cp	extreme dwarf	cp/cp	R. L. Lower (6)

activity showed no trends with respect to growth habits. The peroxidase activity data were subjected to a two-way analysis of variance. Age was found to have a highly significant ($P < 1\%$) effect on peroxidase levels (Fig. 2), while the effect of genotype was not significant. Peroxidase banding patterns from leaves, internodes, and roots of 6 to 8 week old plants indicated that the relative peroxidase activity generally increased with age. Apparently, peroxidase activity in leaves and stems continued to increase long after the organs were fully expanded. This led to the erroneous conclusion in preliminary work that determinate cucumbers expressed greater peroxidase activity.

Our study indicated that variation in peroxidases due to age and location in the plant greatly exceeded the variation due to differences in growth habit genotype. Thus, peroxidases do not appear useful as biochemical genetic markers for the identification of cucumber growth habit genotypes. However, the results suggest that peroxidases are highly correlated with the physiological age of the tissue. Although the nature of these correlations was not pursued, it is important to recognize physiological effects when peroxidases are used to differentiate genotypes. It is possible that a difference in peroxidase activity attributed to a genetic difference may actually be due to a difference in physiological age of the tissue.

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Mechanical Stresses and Muskmelon Fruit Quality¹

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Abstract. Muskmelons (*Cucumis melo* L.) at standard harvest maturities tolerated mechanical stresses, such as dropping 90-120 cm or squeezing with 31.8 kg force, without showing increased damage rates. There were no important differences found between 4 cultivars and 1 breeding line.

During the 1960's attention was focused upon excessive damage done to melons in packaging and shipping operations. Fruit was bruised seriously by forceful packing and lidding of bulge-pack crates. Rough handling plus improper stacking and loading increased fruit damage (5,6,7,8,9,10,14). A

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grower-shipper education program (11) was successful in reducing such damage, however the supposed bruise susceptibility of western muskmelons may have been over-emphasized.

Grower-shippers must be convinced that new methods will protect market acceptability and quality (1) before they will fully accept mechanical harvesting and handling systems for muskmelon production. Even though mechanization is a logical alternative to increasing labor problems and costs, melon growers have been reluctant to use mechanical devices for fear of injuring fruit (unpublished survey).

Studies were undertaken to quantitatively relate fruit injury to controlled mechanical stress. For all tests during a 3 year period, spring and fall crops, 'PMR 45' was grown along with 'Jacumba', 'Top Mark', 'Gulfcoast', or UA 407. Melons produced in a manner comparable to commercial practice were selected to sizes 36 and 27 (number of

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