A Laboratory Method to Evaluate Lettuce Cultivars for Tipburn Tolerance

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ABSTRACT

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Mature plants from eight lettuce (*Lactuca sativa* var. *capitata*) cultivars were selected randomly during harvest from fields in Arizona and California and subjected to a constant temperature of 30 C and 35 ± 5% relative humidity with 12 hr of light (18,000 lux) daily in growth chambers. Plants were rated for tipburn incidence and severity after 3 and 5 days. Field and laboratory ratings for tipburn tolerance of the cultivars were consistently correlated.

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Tipburn, a nonparasitic disease of lettuce (*Lactuca sativa* var. capitata L.) occurs throughout the world and in all lettuce growing areas of the United States. The disease is sporadic but usually occurs in nearly mature lettuce grown during warm weather. Symptoms are necrotic breakdown of the marginal leaf tissues within the heads, accompanied by darkening of veins in or near necrotic areas (10). Symptoms generally are restricted to leaves inside the heads and thus are evident only after removal of several outer leaves. This hidden symptomology prevents selective harvest of uninfected heads; consequently, fields with even a small percentage of diseased plants often are abandoned. Disease severity increases little if at all after harvest in heads in cool storage (10).

Several environmental factors have

Table 1. Field and laboratory tipburn severity index of lettuce cultivars grown in eight fields

Cultivars Rating location	Severity index[a] in field 1	2	3	4	5	6	7	8	Mean	SD[b]	CV[b]
Monterey											
Field	2.27	1.67	1.42	1.10	1.00	0.55	0.17	0.13	1.03	0.74	0.72
Laboratory	3.12	2.02	3.18	2.99	3.11	3.20	3.34	2.40	2.92	0.46	0.16
Calicel											
Field	2.09	2.17	1.33	0.81	0.99	0.72	0.13	0.17	1.05	0.77	0.73
Laboratory	3.24	1.24	3.40	2.63	2.07	3.51	1.87	1.3	2.4	0.92	0.38
Morangold											
Field	0.55	0.61	0.29	0.22	0.18	0.19	0	0	0.25	0.22	0.88
Laboratory	1.80	0.63	2.27	0.57	1.73	1.69	1.25	1.33	1.41	0.59	0.42
K 60											
Field	0.37	0.39	0.30	0.17	0.20	0.07	0	0	0.19	0.16	0.84
Laboratory	2.09	0.62	1.89	0.58	1.28	2.33	1.85	0.74	1.42	0.71	0.50
16 B											
Field	0.07	0.12	0	0.03	0	0	0	0	0.03	0.04	1.33
Laboratory	1.66	0.40	1.77	0.54	1.10	2.22	1.24	0.77	1.21	0.64	0.53
Montimar											
Field	0.04	0.03	0	0	0.02	0	0	0	0.01	0.02	2.0
Laboratory	1.83	0.44	2.00	0.37	0.47	1.96	1.07	0.64	1.10	0.72	0.65
Salinas											
Field	0	0	0.09	0	0	0.02	0	0	0.01	0.03	3.0
Laboratory	1.12	0.87	1.34	0.96	1.49	0.87	1.31	1.00	1.12	0.23	0.2
Calmar											
Field	0	0.05	0	0.03	0	0	0	0	0.01	0.02	2.0
Laboratory	0.85	0.49	0.98	0.9	0.54	1.10	1.09	0.63	0.82	0.24	0.29

[a] Mean rating of heads with tipburn symptoms on scale from 0.5 (very slight) to 5.0 (severe). Each figure represents average rating of 90–100 heads in the field and 30–40 heads in the laboratory.
[b] SD = standard deviation, CV = coefficient of variation (SD/mean).

been suggested to influence development of tipburn (1–6,8,10,12,13,15–17). Based on our results (10,11) and those of others (1–3,6,9,12,13–16), however, we believe that temperature, calcium nutrition, and cultivar susceptibility are the most important influences on development and severity of tipburn.

Except for the use of resistant cultivars, no satisfactory method for tipburn control has been developed. However, evaluation of lettuce cultivars for tipburn tolerance has been happenstance because of fluctuation of weather conditions that influence natural development of tipburn. Tipburn does not develop in field trials, even in very susceptible cultivars when environmental conditions are not favorable for disease development. Because of this uncertainty associated with screening lettuce cultivars in the field, we have developed a method for evaluating tipburn tolerance of lettuce cultivars under controlled conditions.

MATERIALS AND METHODS

Eight cultivars of head lettuce with different levels of field tolerance to tipburn were planted in eight field plots throughout California and Arizona between 1977 and 1979. Between 90 and 100 early mature plants (about 12-wk-old) of each cultivar were rated for tipburn incidence and severity in the field. Tipburn severity was estimated on a scale of 0.5–5.0 indicating slight to severe symptoms.

Uniform plants of each cultivar also were collected randomly for tipburn rating in the laboratory. Between 30 and 40 mature detached heads of each cultivar were subjected to a constant temperature at 30 C and 35 ± 5% relative humidity with 12 hr of light (18,000 lux) daily in growth chambers. Plants were rated for tipburn incidence and severity after 3 and 5 days according to a procedure described earlier (10).

RESULTS

Symptoms that developed on plants subjected to tipburn-inducing conditions in the laboratory were identical to those in the field (10). Results of field and laboratory tipburn tolerance evaluations of lettuce cultivars showed a close correlation. The coefficient of variability of the laboratory ratings also was much lower than that of field ratings, indicating greater reproducibility and accuracy of laboratory versus field evaluation (Table 1). Cultivars such as Calmar, Salinas, and Montemar, which were the most tipburn tolerant in the field, consistently received the lowest severity ratings in the laboratory. Susceptible cultivars such as Monterey and Calicel received the highest ratings, and moderately susceptible ones such as Morangold and K 60 received intermediate scores.

DISCUSSION

Our rationale for using mature, detached lettuce heads for laboratory rating was based on field observations that tipburn usually occurs in mature plants during the last 2–3 wk before harvest. The difference in susceptibility of young and mature plants might be due to physiologic differences and may explain the reported absence of a direct correlation between tipburn ratings in mature fieldgrown plants and in young plants of the same cultivars grown in the greenhouse (7). This lack of correlation might also be due to differences in the environmental conditions in the greenhouse and field. Our approach reduces environmentally induced variations by comparing test plants grown to maturity under normal field conditions before laboratory rating.

The consistent correlation between field and laboratory ratings of cultivars shows that our laboratory method is a reliable way to evaluate tipburn tolerance. Consequently, lettuce breeders now can obtain reliable tipburn tolerance ratings without having to depend on fortuitous occurrence of the disease in field trials.

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