sects may not be necessary until somewhere in excess of 33% of the leaf area is removed, or the pod is in jeopardy. Further experimentation is necessary to substantiate this premise.

ACKNOWLEDGMENT

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LITERATURE CITED


MARGINAL LEAF BLIGHT OF LETTUCE

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ABSTRACT

An epiphytotic of marginal leaf blight affecting lettuce and related crops was observed in the Florida Everglades farming area in the 1966-1967 season. Laboratory tests confirmed the causal agent as Pseudomonas marginalis (Brown) Stevens. Both the field and in-transit phases of the disease probably occur each season to some degree and the potential threat should be of concern to Florida growers and shippers. Suggestions for reducing losses to marginal leaf blight are given.

A bacterial soft rot type disease of lettuce and related crops occurred in epiphytotic proportions during the 1966-1967 season in the Everglades. The disease has been identified as marginal leaf blight incited by Pseudomonas marginalis (Brown) Stevens. This report furnishes the first factual proof of the pathogen occurring in Florida although two previous reports based on symptomatology indicate the disease may have been here for many years (5, 13). O'Neil and O'Neil (10) reported in field grown lettuce and related crops in California (12), New York (8), and Argentina (9). Weber and Foster (13) reported the disease occurred in Florida in 1928, but the symptoms they describe and the fact that lettuce was the only crop involved were in contrast to the commonly observed syndrome and suggests they may have been concerned with some other problem. Friedman (7) reported an in-transit breakdown of imported witloof chicory (Cichorium intybus L.)-incited by P. marginalis. Ceponis and Friedman (4) later reported a leaf spotting and russetting of head lettuce was caused by this bacterium. Cox et al. (5) reported that streptomycin was effective against a lettuce leaf disease that resembled marginal leaf blight. It was not known with certainty that their observations were concerned with P. marginalis. Pseudomonas marginalis has achieved current prominence as a biological tool in the study of enzymatic processes because of its soft-rotting capabilities (4, 10).

Symptoms.—The disease first began on the older, outer leaves of the plant. The initial symptom was a water-soaked area of varying proportions on the leaf margins, usually toward the leaf base. The affected tissue rapidly took on a brown, reddish or black color as the decay advanced. The involved leaf areas were soft and slimy during periods of dew, rain and high humidity, but the lesions became dry, papery and brittle when drier conditions prevailed (Figure 1). In advanced stages of the disease, whole plants were involved and each plant became

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Figure 1.—Marginal leaf blight. A) Naturally infected endive leaf showing characteristic marginal rot. B) Close-up of lettuce leaf showing typical marginal decay.
Table 1.—Comparison of three isolates of *Pseudomonas marginalis* with lettuce bacterium isolate from the Everglades.

<table>
<thead>
<tr>
<th>Character</th>
<th>P. marginalis†</th>
<th>P. marginalis**</th>
<th>P. marginalis***</th>
<th>Lettuce bacterium††</th>
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</thead>
<tbody>
<tr>
<td>Flagella</td>
<td>Polar 1-7</td>
<td>polar 1-3</td>
<td>polar 1-3</td>
<td>polar 1-3</td>
</tr>
<tr>
<td></td>
<td>mostly 1-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capsules</td>
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<td>present</td>
<td>present</td>
<td>present</td>
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<tr>
<td>Gram stain</td>
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<tr>
<td>Green fluorescence</td>
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<td>positive</td>
<td>slight</td>
<td>positive</td>
</tr>
<tr>
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<td>white - creamy</td>
<td>white - creamy</td>
<td>white - creamy</td>
</tr>
<tr>
<td>Gelatin liquefaction</td>
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<td>positive</td>
<td>positive</td>
<td>positive</td>
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<tr>
<td>Nitrile reduction</td>
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<td>negative</td>
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</tr>
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<td>Fermentation:</td>
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<tr>
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<td>acid - no gas</td>
</tr>
<tr>
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<tr>
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<tr>
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<tr>
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<td>Milk</td>
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</tr>
<tr>
<td>Nutrient solution</td>
<td></td>
<td>pellicle</td>
<td>pellicle</td>
<td>pellicle thin</td>
</tr>
</tbody>
</table>

† From Friedman (7).
** Isolated by B. A. Friedman from *Cichorium intybus* L. from Belgium.
*** Isolated from *Phaseolus coccinea* L. in the United Kingdom, 1963.

a slimy, foul-smelling mass. Plants that were lightly affected could be harvested but often extreme stripping was necessary to remove decaying leaves. Seemingly healthy plants or mildly affected plants in an area of a field where the epiphytotic occurred could be harvested but with a substantial risk of in-transit breakdown.

Isolation of the pathogen.—*P. marginalis* was isolated from the following naturally infected hosts: lettuce (*Lactuca sativa* L.) Big Boston, bibb, black-seeded Simpson, romaine, and Great Lakes; escarole (*Cichorium endivia* L.)—full heart Batavian and Florida deep heart; and endive (*C. endivia*)—green curled.

Chinese cabbage (*Brassica chinensis* L.) obtained in the locale of severely affected fields of blighted lettuce exhibited symptoms similar to that on confirmed hosts but attempts to isolate *P. marginalis* from chinese cabbage were unsuccessful.

Isolation of *P. marginalis* from rotting lettuce leaf tissue was often laborious because the involved tissue repeatedly harbored several microorganisms. Even though *P. marginalis* was totally capable of causing extensive tissue breakdown by itself, a complex of several decay microorganisms undoubtedly occurred frequently in the field.

Cultural characteristics.—The cultural tests were conducted with isolate number 67-7, originally isolated from Boston-type lettuce collected near Belle Glade. Table 1 compares the characteristics of the Belle Glade isolate (67-7) of *P. marginalis* to the published description of the pathogen (1, 7) and to two cultures of the bacterium from the International Collection of Phytopathogenic Bacteria (ICPB) kindly provided by Dr. M. P. Starr. Isolate 67-7 compared very closely to the two ICPB cultures in concurrent culture tests, and all three isolates agreed closely to the published description.

Artificial inoculation.—Routine infection of the disease was obtained by atomizing water diluted culture preparations onto susceptible host plants and then placing the plants in a moisture chamber overnight. Predisposition to leaf blight was obtained by a pre-inoculation moisture exposure or leaf wounding by means of a multiple-needle jig.
Figure 2.—Soft rot of cucumber fruit (A) and lettuce head (B) 24 hours after inoculation with Belle Glade isolate of *Pseudomonas marginalis*. Water-inoculated checks on left in A and B.
The Belle Glade isolate and the two ICPB isolates of P. marginalis caused rotting of lettuce heads, cucumber fruit, and potato tubers. Appreciable decay of these inoculated vegetables was evident within 24 hours (Figure 2) and extensive rotting occurred in 4 days. The Belle Glade isolate was considerably more active than the other two isolates in its decay-causing ability. Reisolation of the bacterium from such artificially inoculated tissues was made with ease.

Discussion.—Marginal leaf blight probably occurs to some extent each year in Florida on lettuce and related crops. The disease reached epiphytotic proportions during the winter season of 1966-1967 in the Everglades farming area. The reason for the extreme severity was difficult to determine. Darby (6) suggested that cold temperatures may predispose lettuce tissues to bacterial rots. Affected tissues on plants in the Belle Glade area all appeared to be of the same general age which gives credence to the suggestion of a common predisposing factor. Cold temperatures followed by warm humid days preceded the disease outbreak in 1966-1967.

Marginal leaf blight has gone unrecognized in Florida as an important disease of lettuce. The fact that P. marginalis not only caused a field disease but was also capable of bringing about extensive losses of produce in-transit and in market should be of concern to Florida growers and shippers. No specific control measures for the field phase of the disease have been worked out. The mane (manganese ethylene bisdithio carbamate)—copper sprays failed to give control in the 1966-1967 season. Streptomycin may be effective against the disease (5) but its use does not have the Food and Drug Administration approval. Rotation with a non-susceptible crop may be of value as the bacterium probably lives between seasons in the crop residue. Care in cultivation, harvesting and packing along with rapid precooling should reduce losses. P. marginalis was capable of causing decay at temperatures as low as 36°F (7) so in-transit temperatures of 32-33°F should be maintained.

LITERATURE CITED

SUPERIOR NEW STRAWBERRY CLONES RESIST VERTICILLIUM WILT

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Florida's $8,000,000 strawberry industry, concentrated in west central and southeast sections of the state, produced 20,930,000 pounds of fruit from 2,300 acres in 1965-1966 according to Florida Department of Agriculture records (2). Preliminary 1966-1967 statistics revealed a slight decrease to 2,000 acres; however, the long range outlook of the DARE Report* suggested expansion of this industry in the future (1). Since 1960, acreage in Dade County accounted for 30% of the state production; in 1967, 635 acres were harvested in Dade County.

Research has contributed to the solution of some strawberry production problems with new

*Refers to University of Florida analysis of agriculture industry entitled "Developing Agricultural Resources Effectively."