Florida crop. Bulb mites are closely associated with such diseases as Fusarium yellows, bacterial scab and Stromatinia dry rot (6), all of which are present and at times serious in Florida. Forsberg (3) found that scab could be controlled by controlling mites. Jefferson et al. (6), through fumigation of mite-infested soil, indicated some control of Fusarium yellows, scab and Stromatinia dry rot. Furthermore, Hodson (5) reported that although bulb mites could not attack healthy narcissus bulbs, in numerous cases the mites entirely destroyed the bulbs when previous damage from nematodes, fly larvae or mechanical injury was present. Bulb mites, serious bulb diseases, nematodes and flies are present on gladiolus corms in Florida and wounds are incurred during cleaning and handling of the corms. The standard parathion dip (Tables 1, 2, 3) used for nematodes (7) reduces but does not eliminate mites. Thus, conditions for the development of serious gladiolus diseases are present and the urgency of finding a method of mite control that is safe and compatible with the methods now used for diseases and nematodes is emphasized.

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LITERATURE CITED

The genus *Torreya* (1) is a member of the family Taxaceae, the yew family, and has four recognized species throughout the world—*Torreya taxifolia* Arn. (north Florida); *Torreya californica* Torr. (California); *Torreya grandis* Fort. (China) and *Torreya nucifera* Sied. and Zucc. (Japan). The *Torreya* is an ornamental evergreen with handsome foliage and yew-like, 2-ranked, dark green, linear leaves which emit a pungent odor when bruised, hence at times the usage of the common name “stinking cedar”. Presently, the Florida *Torreya* is preserved in the Torreya State Park, which was named after the rare *Torreya* and is located in Liberty county, 13 miles north of Bristol, encompassing an area of approximately 1,000 acres just east of the Apalachicola River. *Torreya* has also been under cultivation for a number of years in the Alfred B. Maclay Gardens State Park in Tallahassee (formerly designated as Killearn Gardens State Park), where large, handsome specimens of the tree exist and successful methods of propagation are employed to ensure perpetuity of the species.

*Torreyas* generally appear to thrive best in sheltered and shaded areas in moist, well-drained, loamy soils. However, ecological differences exist for the various species. The Japanese *T. nucifera* and Chinese *T. grandis* are much hardier and have been grown as far north as Massachusetts, as apparently also the California *T. californica*, whereas the Florida *T. taxifolia* is much tenderer and confined to a more moderate climate. The Florida *Torreya* occurs as a native tree in Zone 30 of the “Plant Growth Regions of the United States” indicating it could probably thrive well along the coastal regions of the Atlantic up to Georgia and along the coast of the Gulf of Mexico to Texas. Moreover, the “Plant Hardiness Zones of the United States and Canada” indicate an even wider range of possible adaptation and successful perpetuation of the species. Zone 9 is illustrated as an area which includes the coastal plains of the Atlantic Ocean and the Gulf of Mexico, as well as the western coast up to Canada (4). The hard, light yellow, close-grained wood is prized in Japan for cabinet-making and building material, while in the United States it is utilized mainly for fence posts because it is a very durable wood which resists decomposition by wood-rotting organisms.

One of the first observations of a decline of the Florida *Torreya* was made in 1938 by L. T. Nieland, former State Extension Forester for the State of Florida (personal communication). He observed a general unthrifty condition of *Torreya* which worsened with defoliation. At about this same time H. Kurz (3) made a detailed study of the natural habitat of the *Torreya* and its associated ecological and edaphic factors. Kurz in his survey also mentioned in passing that evidence did not substantiate the fact that *Torreya* was vanishing from its natural habitat provided man desists in his efforts at deforestation. In 1962, Godfrey and Kurz (2) reported their observations made in a survey of the *Torreya* in which they concluded that the extinction of the *Torreya* tree was all but an accomplished fact, whereas in 1954, barely 8 years before, they had noticed no abnormal symptoms of decline. The demise of this tree was attributed to man’s efforts at deforestation. Specimens of affected trees were collected and submitted to Erdman West of the University of Florida whose career as a botanist and mycologist ceased with his untimely passing. Obviously, West did not have time to ascertain the causal agent responsible for the decline, but did suggest various fungicidal applications for possible control of the suspected fungal organisms. At this same time, the Division of Plant Industry, Florida Department of Agriculture was approached for aid in combating this problem. The decline of the Florida *Torreya* was at its worst during this period.

**Experimental Procedure**

*Torreya*, whether native or cultivated trees, exhibit similar stem and needle blight symptoms. The symptoms appear to be initiated on the needles which show small, circular, tan spots, usually one to a few in number, enlarging or coalescing until the entire needle becomes necrotic (Fig. 1). Invasion by the causal agent progresses through the needle into the stem, followed by abscission of the needles. As various degrees of defoliation become manifest, the stems appear essentially bare with small tufts of new growth at the tips (Fig. 2). Fungous fruiting structures occur on stems and the undersurface of needles as well as on bud scales when the tissue is wholly necrotic (Fig. 3). These undoubtedly supply inoculum for successive infection of new growth and other unaffected portions of the tree. As new growth ensues, the disease
spreads to these and other unaffected portions of the tree. Seedlings as young as 6 months exhibit symptoms similar to those of mature trees, but defoliation is not as pronounced. In a few cases, cankered stems were observed to occur on affected and dead Torreya trees. Moreover, it was also observed that, in general, the most severely affected trees were those that were growing unsheltered in full sunlight. In the spring of 1967 increased attention was given to the Torreya disease and maneb fungicide at the rate of 1 1/2 lb per 100 gal was recommended for disease control as the investigation continued.

Repeated sampling and collection of affected Torreya trees was made from 1961 to the present time from the Torreya State Park and the Alfred B. Maclay Gardens State Park. Diseased plant material and soil samples were processed and a number of isolations of microorganisms from affected tissues were established. Young seedlings from 6 to 12 months old were used in an inoculation experiment in an attempt to establish pathogenicity of any one or number of isolates obtained in culture by reproducing the disease. Crushed and blenderized stem and leaf litter containing fungal organisms was also used in this infectivity trial. Two pure slant cultures (on potato dextrose agar—PDA) of a fungus isolate identified as Macrophoma Berl. and Vogl. and leaf and stem litter were used as inocula. Each culture was blenderized in 100 ml of water for 1 min and atomized onto three Torreya seedlings. One hundred grams of leaf and stem litter were also blended for 1 min, filtered through six layers of cheesecloth and the resulting filtrate similarly applied to seedlings. The controls contained a like number of plants and were atomized with PDA only. All inoculated plants were placed in a moist chamber for 3 days and then removed to a greenhouse bench for observation.

RESULTS AND DISCUSSION

The sum total of isolations of established cultures of microorganisms produced the following fungi: Macrophoma sp., Sphaeropsis sp., Sclerotium rolfsii Sacc., Rhizoctonia solani Kuehn (Plant Disease Records, Div. of Plant
Fig. 3.—The stem and needle blight of Torreya taxifolia showing fungous fruiting structures on branches and on the undersurface of needles.

Industry, Fla. Dept. Agr.). A fungus tentatively identified as Physalospora Niessl was also observed to occur frequently on stems and needles in association with Macrophoma; however, it was never successfully established in pure culture despite many repeated attempts at isolation of single spores. These monosporic isolations invariably resulted in established cultures of Macrophoma. No organism was successfully isolated from cankered stems.

The inoculation experiment designed to test the pathogenicity of Macrophoma isolates, as well as the infectivity of naturally occurring fungi containing Macrophoma and Physalospora on the leaf and stem litter did not result in a reproduction of the disease in the 6-month duration of the trial.

The recommended application of a maneb fungicide at weekly intervals provided very good control in 9 weeks. The treated Torreya trees showed marked improvement and recovery with much evidence of new growth showing little or no infection.

CONCLUSION

The stem and needle blight disease of Torreya taxifolia appears to be incited by a fungous causal agent which implicates Physalospora and Macrophoma in a manner not yet clearly understood. Moreover, whether there is a relationship between these two fungi based on simultaneous and frequent occurrence on diseased stems and leaves is also a matter of significant inquiry, particularly when attempted isolations of Physalospora invariably resulted in established cultures of Macrophoma. The inability to reproduce the disease implies any number of the following considerations: that special conditions are necessary to establish infection; that an ascigerous stage of the causal agent may be all-important; and finally, that the condition or age of the host tissue may be of considerable import. Clearly, the solution to these and many other facets of this disease lies in additional and persevering investigation.

LITERATURE CITED