PHYSIOGENIC BROOMING IN CHINESE ELM

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In January 1942, specimens of small Chinese elm[1] (*Ulmus pumila* L.) branches bearing numerous galls were submitted to me for diagnosis. The condition was reported to be generally prevalent in a block of 7,000 submature trees valued at $70,000 in pending litigation. The galls were 1 to 3 cm in diameter, hemispherical, roughened with the presence of many adventitious buds, and each bearing 3 to 12 adventitious twigs, nearly half of which were dead. Within the galls the tissues were distorted but not decayed, and an exudation of mucilage, comprising tiny, jelly-like pellets, was noticeable. The galls consisted entirely of hypertrophied phloem and cortex. They occurred only at nodes, and the condition was evidently systemic, as every node on each affected branch bore a gall. Repeated examination failed to disclose the presence of mycelium, fungous fruiting bodies, nematodes, or bacteria in the galled tissues, while the dead twigs bore only common saprophytes. There were no indications of insects or mites or of their activity in the past. For a time the hypothesis was entertained that this was a virus disease comparable to the witches' broom of black locust, but as will be seen, field studies and inoculation experiments did not support this view.

Early in February the block of affected trees, near Oklahoma City, was examined. As is so often the case, the laboratory specimens gave a very inadequate picture of the situation. The trees occupied 320 acres, averaged

[1] More properly called "dwarf elm," but commonly referred to in nursery practice as "Chinese elm."

6 inches in diameter, and were uniformly and severely affected. The conspicuous symptom, however, was not the presence of galls, but rather an abundant brooming, the shortened main branches bearing 5 or 6 times as many small side branches as is customary (Fig. 1). A large proportion of the twigs and many of the larger branches were dead. Side branches frequently departed from their parent branches at abnormal angles. The condition was systemic although occasional normal whips could be found. No phloem discoloration was seen, and there was no wintergreen odor of the scraped inner bark of the lower trunk, indicative of phloem necrosis. Apart from a few mechanical injuries the roots were normal. Practically all of the Chinese elms in the block were affected, although the few *Ulmus pumila* x *U. americana* hybrids that were present showed no abnormal branching.

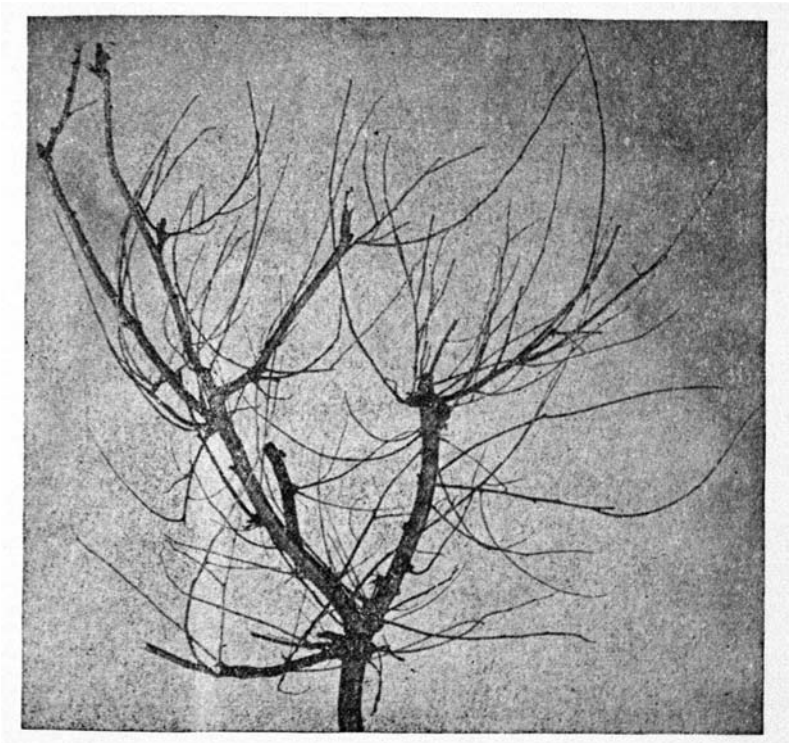

FIGURE 1.

Data on the history of the plantation were obtained both from the lessee and from examination of the trees. The trees, which had been purchased from a Texas nursery, had been standing in their present locations for 12 years. For the first few years they had been well cultivated and fertilized with stable refuse, but they had been somewhat neglected during the past 4 or 5 years. They had been thinned 50 per cent and at the time of examination were spaced about 8 x 12 feet apart. Annual ring counts were made of the various segments of affected branches, and when these were correlated with the presence of dead former leaders, it became evident

that the dieback of terminal twigs had been prevalent in the block for 5 years. The galls and brooming had clearly resulted from the production of adventitious shoots consequent on the dying of terminal and side twigs, and further increase of adventitious shoots following dieback of those first formed.

As to the cause of the dieback, the field observations indicated that it was not contagious. In the first place, although evidence was available that the dieback and brooming had been progressing for 5 years, an examination of many Chinese elms on house lots in the immediate vicinity of the affected tract failed to reveal a single broomed tree, indicating no spread from the tract to adjacent healthy trees. In the second place, opportunity was afforded to examine several hundred trees that had been transplanted from the tract to home sites during the past 2 years. In virtually every case the transplanted trees had fully recovered from the brooming and the new growth was developing at the rate of 3 to 4 feet per year. These trees could be recognized by inconspicious old hypertrophies as having in fact formerly suffered from brooming.

As a check on the rather remote possibility that the brooming might be virus-induced, inoculation experiments were performed. Twenty-five 4-foot healthy Chinese elms were potted on February 12, 1942. Two days later 13 of them were top-worked, each with 2 scions from broomed trees, using whip grafts. In each of 2 additional trees, two ¼-inch holes were bored in the stem and plugged with a tightly fitting core from a diseased branch, the two cambiums placed in contact, and waxed. The remaining 10 trees were reserved as uninoculated controls. Twelve root grafts were also made, using roots from broomed trees and scions from healthy Chinese elms. Within three weeks the scions of both types of grafts began to leaf out. The young trees were held under observation for 8 months. During this period no disease symptoms developed in foliage or twigs of scions or understocks. The appearance of the new growth from the scions taken from broomed trees and that of the normal elms to which they were grafted was indistinguishable from that of the ungrafted check trees and was normal for the species.

These experiments were confirmed by another examination of the affected plantation on April 1, 1942, when the affected trees were in full leaf. There were no leaf symptoms suggesting virus disease. There was some damage by leaf-chewing insects but this was not confined to broomed trees. The affected trees did, however, show a continuation of the broom-like habit of earlier years, with many small, weak shoots, excessive development of side shoots, and an excessive number of abnormally small leaves, giving the trees a feathery or filmy appearance. Such excessive branching would have been expected as a result of the dieback of the preceding year, and would in turn result in the production of many small leaves instead of a normal number of larger ones.

In view of these facts, that no pathogenic organism was demonstrable, that the brooming was not found to be graft-transmissible, that there was no evidence of spread in 5 years from broomed to healthy trees, and that broomed trees recovered in 1 or 2 years after being transplanted to favorable locations, it is concluded that the brooming is a non-contagious, physiogenic disease.

The nature of the primary and contributory environmental factors responsible for the brooming may not have been fully determined but at least some of the factors are known. Soil analysis indicated no major deficiency in nutrients. According to H. J. Harper, Professor of Soils at

the Oklahoma Agricultural Experiment Station, the soils of the area in question are characterized by a large amount of clay in the subsurface layers. Roots of trees in such areas are unable to penetrate the subsoil sufficiently to develop the type of extensive root system needed to withstand the effects of moderate drought with which deep-rooted trees are able to cope. In addition, the history of the case and examination of the trees brought to light a number of injurious factors that doubtless played a part in producing the dieback resulting in brooming. Among these were the severe drought of 1934-1936 which was accentuated by the effect of the clay subsoil and was reflected in the narrow annual rings of those years, defoliation by leaf-feeding insects in 1940 and 1941, the Armistice-Day freeze of 1940 which resulted in widespread injury to tree trunks throughout the Southwest, a disastrous ice storm in the winter of 1939-1940 which caused conspicuous breaking of many scaffold branches, and sunscald resulting from thinning the stand by removing every other row of trees.