

Research Note

HIGH LEVEL OF CHESTNUT BLIGHT CONTROL ON GRAFTED AMERICAN CHESTNUT TREES INOCULATED WITH HYPOVIRULENT STRAINS

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The American chestnut [*Castanea dentata* (Marsh.) Bork.] was greatly valued as a landscape and forest tree in the eastern United States until the chestnut blight fungus [*Cryphonectria parasitica* (Murr.) Barr] killed all but a few trees during the first half of this century. Some of the large American chestnuts that survived the blight epidemic have been found to have low levels of blight resistance (2). These trees typically have had several to many limbs killed by blight. Most of these surviving trees were found to be infected by virulent (killing) strains of the blight fungus and also by strains of the chestnut blight fungus that had low virulence (hypovirulence) (2). Biological control of chestnut blight with hypovirulence has potential (3). In general, however, a high level and long-term control of chestnut blight using hypovirulence (inoculation of cankers with hypovirulent strains) has not been successful in the eastern United States. The present investigation was undertaken to document a high level of chestnut blight control on grafted American chestnut trees, derived from large survivors, which had been inoculated with hypovirulent strains 13-14 years earlier.

Materials and Methods

In May 1980, three American chestnut grafts (TG, RM and TH) were established on three American chestnut rootstocks in an American chestnut plantation at the Lesesne State Forest, Virginia. Large, surviving American chestnut trees [>25 cm diameter breast height (dbh)] growing in Virginia were used as a source of scions. Usually, two scions from each large, surviving American chestnut tree (TG, RM or TH) were bark-grafted into a single rootstock. Natural blight cankers were

present on the main stems of the grafts when they were 2 and 3 years old in 1982 and 1983. These cankers were inoculated with a mixture of European and American hypovirulent *C. parasitica* strains (EP4, EP43, EP47, EP49, EP51, EP60, EP88, EP92, EP171 and EP172) received from J. E. Elliston at the Connecticut Agricultural Experiment Station. The cork-borer method of inoculation (3) was used to inoculate blight cankers with the hypovirulent strains.

A survey of blight on 100 seedling sprout clusters in the chestnut plantation, adjacent to the grafts, was conducted to document the incidence and severity of chestnut blight at this location. The severity of blight and characters of tree health, such as the height, dbh, and visual estimate of percent live crown, were determined for the three grafted chestnut trees. Cankers were rated for severity according to four canker types in decreasing severity of disease: a) sunken, often with exposed wood, b) irregularly swollen and sunken, c) callused and swollen and d) superficial and swollen. Thickness of healthy and necrotic bark in cankers was determined with micro-core (1.7 mm diameter) samples of bark tissue and a ruler.

Results

The survey of 100 American chestnut sprout clusters showed that 100% had chestnut blight, 100% had one or more stems killed by sunken cankers, and for 95% of the sprout clusters, the largest stem had been killed by blight. Active blight cankers with stromata (fungus sporulation structures) were frequent. Low blight severity and a high level of health for the chestnut grafts are indicated in Table 1.

Table 1. Characters of blight severity and tree health for three 16-year-old grafted American chestnut trees inoculated with a mixture of hypovirulent strains of *Cryphonectria parasitica* 13-14 years earlier.

Character ^d	GRAFTED TREE		
	TG	RM	TH
Diameter at breast height (dbh) of largest stem, cm ¹	31.2	33.5	33.8
Tree height, m ¹	12.1	14.6	17.1
Per cent tree crown alive ¹	85	90	95
Number of blight-killed branches ¹	4 ²	2 ²	3 ²
Number of swollen, superficial cankers ^{1,3}	23	32	34
Number of sunken cankers ^{1,3}	1	1	1
Number of callused and swollen cankers ^{1,3}	1	3	1
Number of irregularly swollen cankers ^{1,3}	2	1	1
Mean thickness of healthy bark adjacent to vascular cambium in superficial cankers, mm	8.3 ⁴ ±1.4	8.7 ⁴ ±1.0	7.0 ⁴ ±1.2
Mean thickness of dead outer bark in superficial cankers, mm	2.1 ⁴ ±0.7	2.4 ⁴ ±0.9	2.3 ⁴ ±0.9

¹ Determined September, 1996
² All were low, small branches in partial shade, except one.
³ Cankers on live branches and stems. TG had 1 stem, and RM and TH had 2 stems. Scions were from large survivors.
⁴ Based on 10 bark core samples of main stem cankers per grafted tree. Variation expressed as standard deviation.

Discussion

The chestnut blight survey indicated that virulent inoculum and chestnut stem death were widespread adjacent to the chestnut grafts at the Lesesne State Forest. The evaluations reported here indicate that a high level and a long period of chestnut blight control were obtained following inoculation of natural blight cankers on the chestnut grafts with a mixture of hypovirulent strains. A high level of blight control is indicated by few blight-killed branches and a large percentage of cankers that were rated as superficial. Further, the swollen, superficial cankers on the three grafts are the most superficial (high ratio of non-necrotic to necrotic tissue) observed during a 20-year period of core sampling of superficial cankers on American chestnut (G. J. Griffin, unpublished).

Some chestnut blight control (abnormal cankers and more live stems per chestnut sprout clump) has been observed 9 years after inoculation of forest American chestnuts with hypovirulent strains (1), but we know of no published reports documenting a high level and long period of blight control, following inoculation with hypovirulent strains, in the natural range of American chestnut.

Although no data are available, we observed an apparent high level of chestnut blight control in Connecticut for orchard American chestnut trees inoculated with a mixture of hypovirulent strains (G. J. Griffin visit to Lockwood Farm with J. E. Elliston). Research is in progress to evaluate factors that may be contributing to the high level of blight control exhibited by these grafted chestnut trees.

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Literature Cited

1. Anagnostakis, S.L. 1990. *Improved chestnut tree condition maintained in two Connecticut plots after treatments with hypovirulent strains of the chestnut blight fungus*. For. Sci. 36:113-124.
2. Griffin, G.J., F.V. Hebard, R. Wendt, and J.R. Elkins. 1983. *Survival of American chestnut trees: evaluation of blight resistance and virulence in Endothia parasitica*. Phytopathology. 73:1084-1092.
3. Jaynes, R.A. and J.E. Elliston. 1980. *Pathogenicity and canker control by mixtures of hypovirulent strains of Endothia parasitica in American chestnut*. Phytopathology. 70:453-456.

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