Chestnut Blight in Southern Switzerland: Influence of Hypovirulence and Management Practice

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ABSTRACT. In Switzerland, the main chestnut *(Castanea sativa)* growing areas are located south of the Alps. There, chestnut is the dominant tree species of the colline region, covering over 15,000 ha. The European chestnut south of the Alps has been exposed to chestnut blight *(Cryphonecma parasitica)* for over 40 yr. The survival of C. *sativa* is due primarily to its reduced susceptibility toward *C. parasitica* compared with *C. dentata,* and to the appearance of hypovirulent strains of the fungus. During 1988, an investigation to verify the distribution and the severity of the disease in southern Switzerland was undertaken. The field observations confirmed the wide distribution of the disease and showed the predominance of superficial cankers (probably due to hypovirulence) in all of the areas investigated. The disease situation in a particular forest stand seems to be more dependent on management practice and management intensity rather than on site conditions. Due to the presence of only a few vegetative compatibility groups of the fungus together with the fact that the chestnut stands are mostly mature and not under active silvicultural management, the disease situation has improved. There is evidence for the presence of substantial inoculum of virulent strains of *C. parasitica,* which could be an obstacle to intensify chestnut cultivation. Presently, there does not seem to be any danger for the survival of the species south of the Alps. Chestnut fruit groves can be revived and improved, provided all the necessary health-maintaining interventions characterizing modern chestnut cultivation are undertaken.

In Switzerland, chestnut forests are found mainly in the southern part of the Alps. There, chestnut is the dominant tree species of the submontane region that covers over 15,000 ha. In 1948, when the first chestnut blight (Cryphonectria parasitica [Murr.] Barr) focus was discovered in southern Switzerland (1), there was fear that the epidemic might destroy all the chestnut stands south of the Alps (5). Fortunately in southern Switzerland, like in other parts of Europe, the disease did not spread as fast and did not cause as high a mortality as in the United States at the beginning of this century (8).

A survey in 1%3 showed that 15 yr after its first detection in the very southern part of the Alps, the disease had not yet reached chestnut stands at high elevations. Thus, due to the topography, the intensity of the epidemic showed a clear south-north gradient (2). The slow evolution of the epidemic was primarily due to the reduced susceptibility of *Castanea saliva* Mill. toward *C. parasitica* when compared to *Castanea dentata* (Marsh.) Borkh. This property probably allowed the establishment and natural spread of hypovirulent strains of the fungus. The wide distribution and the dominance of hypovirulent strains in the chestnut area of southern Switzerland was confirmed

by fungal isolation (3). The natural abundance of hypovirulence in the southern part of the Alps favored the spontaneous and continuous regression of the chestnut blight epidemic. According to Bazzigher et al. (3), this favorable development was primarily due to the limited number of v-c groups (only 5 main groups) and to the existence of some isolates that belong to more than one v-c group.

In 1988, informed by the Forest Service of new outbreaks of *C. parasitica,* a preliminary investigation was undertaken to reassess the distribution and the severity of the disease in southern Switzerland. The main objective was to detect new disease foci, determine their geographical distribution and evaluate possible causes for the observed increase in disease (4).

MATERIALS AND METHODS

The assessment of the distribution of chestnut blight was done in combination with the National Forest Inventory of 1988 on forest stands of the Canton Ticino. The survey was conducted by samping all chestnut trees located on a cross point of the 2 km square sub-net of the sample plots of the National Forest Inventory. The sample plots are circular and measure, according to the developmental stage of the stands, 200 to 500 m^2 (9). Because of the preliminary nature of this investigation, the main objective was to assess disease severity and to judge whether infected branches would survive. No fungal isolations were made to determine whether the cankers were caused by virulent or hypovirulent strains of *C. parasitica.*

The following traits were observed:
a. on sampled trees:
1. number of typical cankers on trunk and main branches
2. number of non-typical (scarring or swollen) cankers on trunk and main branches
3. number of epicormic shoots below canker (either green or wilted.)
4. proportion of dead crown due to former blight attacks
5. wilted leaves in the crown due to recent blight attacks

b. within sample plots
1. type of silvicultural management (orchard = selva, coppice forest, chestnut as subordinate species *in* mixed stands)
2. quality of silvicultural management (i.e. regular, abandoned, fire damage)

RESULTS

A total of 74 plots were observed (Table 1). Out of the 53 coppice or orchards sites, only one was judged as regularly managed. Seven sites showed traces of fires, whereas the other 45 sites were judged as abandoned. Altogether, 636 cankers were observed. Only 35 (5.5%) were judged as typical, whereas 601 (94.5%) showed signs of scarring and healing and were judged as non-typical (Figure 1).

Epicormic shoots were found below 83 of the 636 cankers (13.1%). The high frequency of green epicormic shoots (53 cases) proves the aggressive character of *many* infections (Figure 1). Eighty-one of the 557 observed trees (14.5%) had dry branches with wilted leaves in the crown. This high proportion of recent infections on branches is a sign of the wide distribution of virulent strains. In addition, 136 of the 557 evaluated trees (24.4%) still show signs of former blight attacks.

Table 1 shows the distribution of the disease symptoms on the investigated plots. The data confirm the wide distribution of the disease in the whole area of investigation. Most of the orchard and coppice sites show signs of blight. In contrast, in mixed stands, where the chestnut is just a subordinate tree species, disease incidence is low.

DISCUSSION

The field observations confirmed the wide distribution of the disease and showed the predominance of non-typical cankers (probably due to hypovirulence) in all the areas investigated. Compared to the investigation of 1964 (2), the disease severity has clearly decreased throughout the area of investigation. A similar status of disease development also was noted in other mediterranean regions ([7]).

Our data analysis suggests that the general and spontaneous decrease of the disease severity, associated with

Table 1. Disease symptoms on plots with respect to management procedures.

	Symptom Classes/Number of Plots						
Management Type	No Cankers	Atypical Cankers	Non-Typical Cankers & Wilted Leaves	Non-Typical & Typical Cankers	Typical Cankers	Wilted Leaves	Total
Orchard	4*	1	5	6	2	3	21
Coppice	3	9	10	9	0	1	32
Mixed Stands	13	4	1	0	0	3	21
Total	20	14	16	15	2	7	74

*Number of Plots

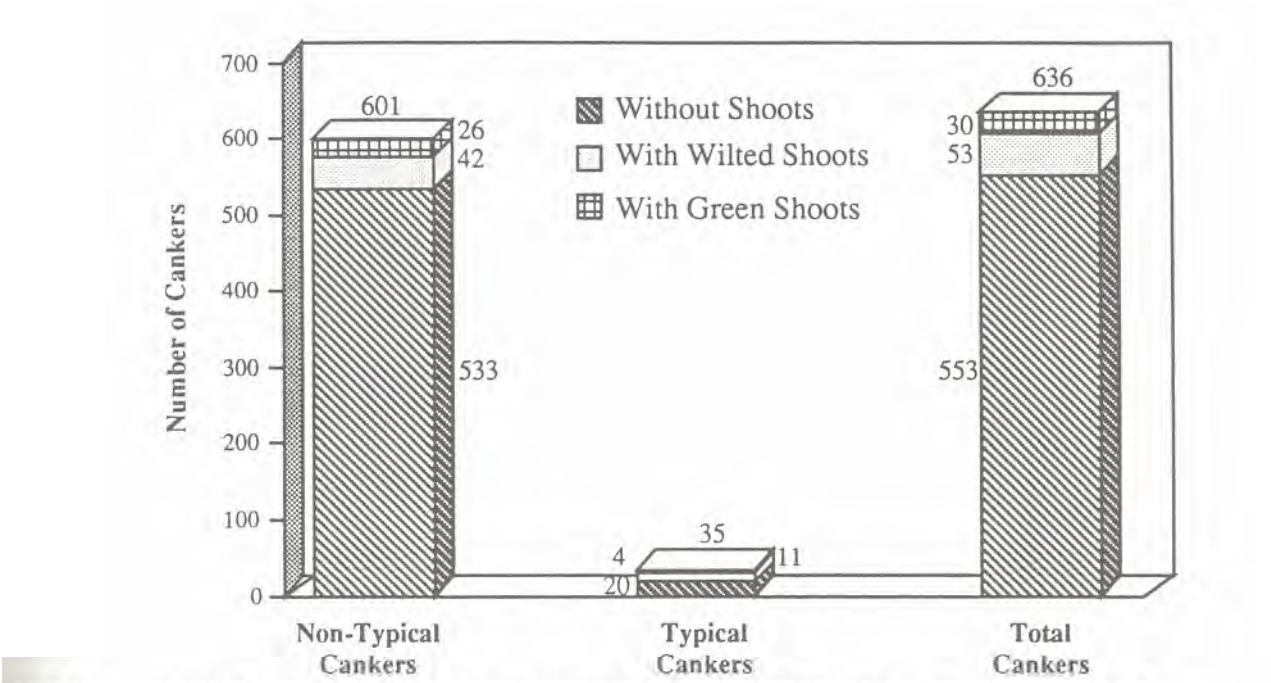

Figure 1. Observed cankers: number and types of cankers without epicormic shoots, with wilted and with green epicormic shoots.

the wide diffusion of the hypovirulence, was strongly favored by the neglect of silvicultural management in the chestnut stands of the region. In fact, in mature stands, hypovirulent strains with low sporulation have a better chance to diffuse. In clearcuts and short rotation stands, hypovirulent strains are easily eliminated. Because of the better chances to diffuse, the virulent strains are temporarily dominant and attack the young and susceptible shoots (6).

There is substantial evidence for the continued presence of virulent inoculum of *C. parasitica* (i.e. high number of trees with wilted branches in the crown and high percentage of green epicormic shoots) that could still constitute an obstacle to intensifying chestnut cultivation. However, for the present time there does not seem to be any danger of the survival of the species south of the Alps.

The data presented suggest that the locally observed increase in disease severity is due to silvicultural practices (clearcuts with elimination of the hypovirulent strains), to meteorological events like heavy hail storms (causing infection points in the crown) or drought periods (possibly causing reduction of the resistance in chestnut trees). Even if many chestnut stands are abandoned, we believe that the chestnut fruit groves can be revived and improved, provided all the necessary health-maintaining interventions characterizing the modern chestnut cultivation are undertaken. Particular attention must be paid to not eliminate, through silvicultural management, the hypovirulent inoculum that is spontaneously controlling the disease.

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