MANAGEMENT OF BEECH STANDS INFECTED BY CRYPTOCOCCUS FAGISUGA IN WEST GERMANY[1]

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Abstract.--Beech trees in an experimental plot in the Odenwald (southwest Germany), with different intensities of attack by Cryptococcus fagisuga Lind. since at least 1970, were observed from 1972 until 1982 in order to ascertain the role of scale insects in beech bark disease and to facilitate decisions for the management of infested stands. At the beginning of the research 13% of the dominant trees were infested by C. fagisuga. Until 1979 the attack decreased continuously, only in the dry years 1975 and 1976 did the number of trees with moderate attack increase. Since 1980 new infestations on previously uninfested trees have been observed. Eighteen per cent of the trees, which had been moderately or heavily attacked in 1972, died during the following years. The recovered trees exhibited pathological bark induced by the sucking activity of the scale insects. According to these results, practising foresters are recommended not to do a sanitation felling, if locally not more than 6% of the beech trees reach the attack class moderate or heavy.

INTRODUCTION

Practising foresters in Germany are advised by the forest protection authorities to fell beech trees suffering heavily from beech bark disease immediately in order to avoid losses in timber value and to eliminate sources of infection. However, the logging should be done carefully in order to keep changes in the stand structure as small as possible since it is known that even heavily attacked beech can regain health. If there are many trees with bark necrosis, the forester has to consider, whether timber loss or changes in the stand structure is of higher ecological or economic importance. Therefore he urgently needs advice for decision making. In order to gather information on the course of the disease, the Department of Forest Protection of the Forest Research Institute in 1970 established a sample area within a stand heavily infested by the beech scale, Cryptococcus fagisuga Lind. The trees selected and marked for observation have been checked at annual intervals since 1972. The following results are a supplement to those obtained by Rhumbler (1931) in north Germany in the first quarter of this century.

Experimental stand and methods

The experimental plot covers an area of 3.3 ha in the Odenwald in southwest Germany. It is situated on a northeast slope about 350 m above sea level. The stand consisting of 80% beech (Fagus sylvatica L.) was initiated in the seed year 1888. It was thinned for the first time after about 40 years; the last selective logging was in 1978.

Beginning in 1972 every autumn I determined the degree and extent of the white woolly wax secretions on the lower 4 m of the trunk of 96 marked beeches using three classes of infestation: light (1), moderate (2) and heavy (3). I registered the position (height and direction) of the densest cover, from which I took a bark sample in order to determine the vitality of the scale insects by means of a microscope. Furthermore I described the structure of and the injuries to the bark, and finally I noted whether

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there were slime flux spots or fruit bodies of Nectria coccinea and white-rot fungi.

RESULTS AND DISCUSSION

At the beginning of the investigation 7% of the trees in the experimental plot were attacked lightly, 5% moderately and 1% heavily by C. fagisuga. The infestation of 96 marked sample trees reached the highest level in 1972, and declined continuously until 1979. Only in the dry years 1975 and 1976 and in 1982 did the number of beech trees with moderate attack (class 2) increase clearly (Fig. 1). However, changes in density of C. fagisuga could not be correlated with annual weather conditions, as has been done by Schindler (1962) in north Germany.

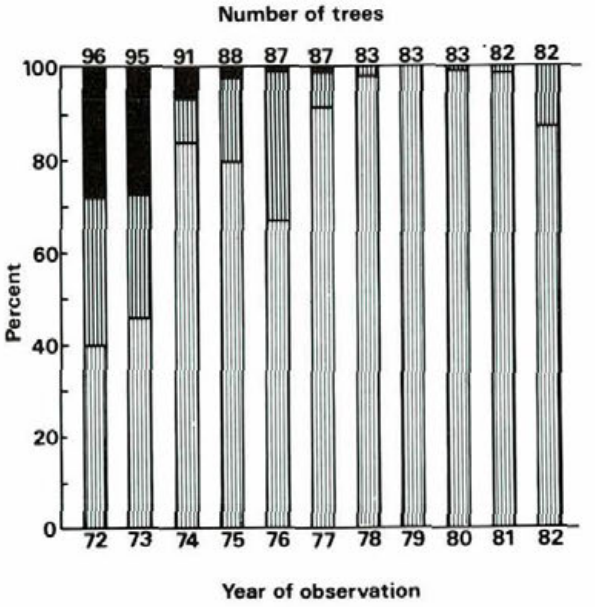

Figure 1.--Percentage of the sample trees attacked lightly (light line), moderately (heavy line) or heavily (black) by Cryptococcus fagisuga in the years from 1972 till 1982.

Slime fluxing was observed on 10 trunks. The first spots on the bark of one tree appeared in 1975. The occurrence of new spots culminated in 1976 with six trees affected. Two followed in 1977 and one in 1978. It appears that slime fluxing was induced by warm and dry weather. The level of the beech scale density appeared to have had no influence on the production of slime flux spots, because they were found on trees having had heavy, moderate and light infestations. Trees without any scale attack never showed slime fluxing. Only one of the trunks with tarry spots snapped during the observation period; this was two years after the appearance of the exudations. The other trees recovered.

During the whole observation period (1972-1982) I never found fruit bodies of Nectria or white-rot fungi on trees not yet broken, except for one beech with fruit bodies of Inonotus nodulosus (Fr.) one year before snapping of the trunk.

Of 96 sample trees 13 died or were missing of which 10 belonged to the dominant stand components and three were suppressed (Table 1).

Table 1.--History of sample trees dying between 1972 and 1982

Tree No	Crown class	Attack class in the year 1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	suppressed	1	1	1	1	dry[a]					
2		2	2	1	1	1	1	1	1	1	dry[a]
3		3	2	1	1	1	1	dry[a]			
4	dominant	2	2	1	1	1	1	snap			
5		3	3	1	decaying			snap			
6		3	3	dry[b]							
7		3	3	snap							
8		3	snap								
9		3	snap								
10		3	snap								
11		1[c]	1	missing							
12		3	3	1	1	2	0	missing			
13		3	3	2	missing						

Dry = Standing tree with no leafing

a Suppression
b Beech bark disease
c Heavy attack above 4 m

The suppressed trees died without snapping and the scale attack only accelerated the natural die-back. Five of the dominant trees (tree numbers 6-10) snapped or died in the second or third year after the heaviest attack, two suffered a long decline promoted by the dry period in 1975/76 (tree numbers 4 and 5). The remaining three trees disappeared for unknown reasons. Because of the heavy attack in 1971-72 I classified them as having died from the beech bark disease. With one exception (tree number 4) every decaying tree of the dominant stand level has been heavily attacked by the beech scale before.

Rhumbler (1931) called trees with moderate or heavy attack "scale-insect-beeches" (Lausbuchen). After the C. fagisuga outbreak in the Odenwald, 10 of 56 scale-insect-beeches (18%) and 9 of 17 trees (53%) belonging to attack class 3 died. Since only 5% of all (dominant) beech trees were moderately attacked and only 1% were heavily infested, the losses remain small relative to the whole stand.

In Lower Saxony, 17% of scale-insect-beeches

Plate 1.--Dead bark of a beech formerly infested by Cryptococcus fagisuga partly removed (right picture) to show the formation of wound callus.

died during an outbreak in the first quarter of this century. This value agrees well with that of Baden-Württemberg (18%).

The fact that slime fluxing was observed on 47% of scale-insect-beeches in Lower Saxony compared to only 7% in Baden-Württemberg makes it necessary to contradict the general opinion of foresters that appearance of slime flux spots can be used as a measure of the severity of the disease.

It was pointed out by Rhumbler (1931) that one can expect 80% of scale-insect-beeches to recover. However, the disease does not disappear without leaving a trace. The bark surface shows distinct marks originating from attacks in previous years. If bark dies on a larger area, there remain wounds which slowly occlude Plate 1). If a rhytidome can be built up, the bark cracks later on and fissures appear, because sclerotic phloem rays prevent the formation of a normal interior periderm (Braun 1976, 1977) (Plate 2).

CONCLUSIONS FOR FOREST MANAGEMENT

Quantitative studies on the influence of beech bark disease on individual trees in the timber stage in north and south Germany in different years have shown that less than 20% of beech trees moderately or heavily infested by C. fagisuga died. It is not possible to recognise these trees in advance. Therefore it is recommended not to do an extra logging, if no more than 6% of the dominant stand components are infested. According to our experiences the financial loss remains small, whereas extra logging is expensive, and moreover, it often interferes with silvicultural concepts. Diseased or dead trees remaining in the stand do not increase the risk to healthy trees. Of course, removing trees heavily infested by the beech scale reduces the number of crawlers invading neighbouring trees. But there are enough larvae, coming from lightly attacked trees, to infect those disposed to the disease (Wainhouse, 1980). The same holds true for fungi. Mülder and Zycha (1980) pointed to the fact, that spores are present everywhere. Certainly, scale-insect-beeches should be watched carefully, when routine quality thinning is done. Trees with bark showing marks of former attacks should also be favoured for felling because each necrosis reaching the cambium induces timber damage and discoloration, resulting in quality loss (Wujciak 1976).

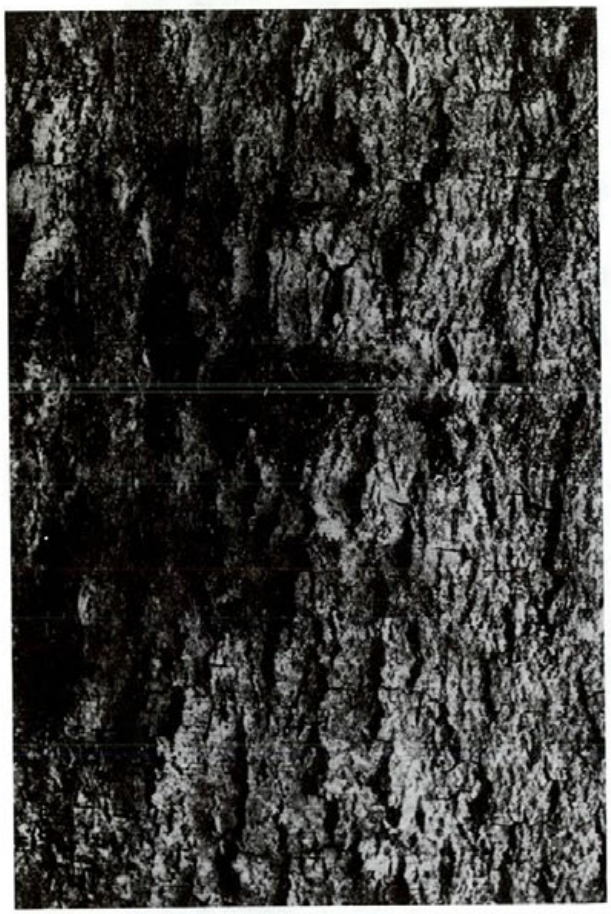

Plate 2.--Abnormal (cracked) bark of a beech induced by Cryptococcus fagisuga.

ZUSAMMENFASSUNG

Im Jahre 1970 unterschiedlich stark von Cryptococcus fagisuga Lind. befallene Buchen auf einer Versuchsfläche im Odenwald (Südwestdeutschland) wurden bis 1982 beobachtet, um den Einfluss der Läuse auf den weiteren Verlauf der Buchenrindennekrose zu ermitteln und um der forstlichen Praxis Entscheidungshilfen bei der Behandlung von verlausten Beständen zu geben.

Zu Beginn der Untersuchung waren 13% der herrschenden Bäume von C. fagisuga befallen. Bis 1979 nahm der Befall kontinuierlich ab, lediglich in den Trockenjahren 1975 and 1976 stieg die Anzahl der Bäume mit mittlerem Befall an, Seit 1980 ist wieder eine schwache Zunahme der Verlausung festzustellen.

Von den Buchen, die 1972 mittleren oder starken Befall aufwiesen, sind in der Folge 18% gestorben. Die wieder gesunden Bäume besitzen heute pathologische Rinden, deren Entstehung durch die Saugaktivität der Läuse ausgelöst wurde.

Aufgrund der vorliegenden Ergebnisse wird der Forstpraxis empfohlen, auf sanitäre Hiebe zu verzichten, wenn lokal nicht mehr als 6% der Buchen verlaust sind (d.h. der Befallsklasse mittel oder stark angehören).

RÉSUMÉ

Dans le but de préciser le rôle de la cochenille dans la maladie de l'écorce du hêtre et pour faciliter les décisions des aménagistes de peuplements infestés, on a observé annuellement de 1972 à 1982, des hêtres montrant différentes intensités d'attaques par le Cryptococcus fagisuga Lind. depuis au moins 1970. Ces arbres étaient situés sur des parcelles expérimentales situées dans le Odenwald (sud-ouest de l'Allemagne). Au début de nos observations, 13% des arbres dominants étaient infestés par le C. fagisuga. L'infestation a diminué constamment jusqu'en 1979, sauf dans les années sèches de 1975 et 1976 où le nombre d'arbres avec infestation modérée a augmenté. Depuis 1980, des infestations ont été observées sur des arbres antérieurement non touchés. Dix-huit pour cent des arbres modérément ou sévèrement attaqués en 1972 moururent dans les années subséquentes. Les arbres survivants montraient des malformations pathologiques de l'écorce causées par l'activité de la cochenille. Selon ces données, nous conseillons aux forestiers de ne pas faire de coupe d'hygiène si moins de 6% des hêtres sont dans les classes d'attaques modérées et sévères.

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