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The phytosanitary state of poplars in Belgium in 1991

M. STEENACKERS

Ministry of the Flemish Community
A.M.I.N.A.L.
Institute of Forestry and Game Management[1]

Summary

A summarizing overview of the current research with regard to the main poplar diseases such as *Melampsora* sp. and *Xanthomonas populi* is given.

For *X. populi* altogether 80 isolates have been collected in the whole Belgian territory and they have been systematically compared with regard to their virulence and aggressiveness.

The perfected artificial infection technique appears to be extremely efficient and reliable, even after many years, so that it can be concluded that the resistance, present in many clones has not been broken down.

M. larici-populina clearly turns out to occur frequently in Belgium and may have a large influence on the growth of sensitive clones. The presence of several physiological races was stated, as well as the specific sensitivity of some clones to the different races.

M.allii -populina, though present, seems to influence plant growth less.

Introduction

In northwestern Europe poplar cultivation is mainly based on poplars belonging to the sections Aigeiros (*P.deltoides* and *P. nigra*) and Tacamahaca (*P. trichocarpa* and *P. maximowiczii*) and their hybrids.

Diseases representing a serious economical threat for these poplars are in the first place the rusts *Melampsora larici-populina* and *Melampsora allii-populina* and the poplar canker caused by the bacterium *Xanthomonas populi* (STEENACKERS, 1966).

Therefore, at the Institute of Forestry and Game Management (the former Poplar Research Centre), which has been specializing in poplar selection and breeding since 1948, only poplar clones with a high resistance to both diseases are selected.

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1. Gaverstraat, 4. B-9500 Geraardsbergen.

1. Resistance to *Xanthomonas populi Ridé* (Ridé and Ridé)

The resistance to *X. populi* is determined by means of artificial infections of the bacterium on 1-year old plants.

This infection technique was developed at the beginning of the sixties at the Poplar Research Centre, in cooperation with M. Ridé (INRA, Angers) (RIDÉ, 1966). The technique implies artificial infections with one bacterial strain of *X.populi* (CNBP 2226 = LMG 5755), originally isolated from *P.eur.* "Regenerata" in 1966 and selected from a series of 10 bacterial strains for its high aggressiveness on several clones.

In order to avoid the loss of virulence and aggressiveness of this strain, it is yearly infected and re-isolated from its original host plant.

Since a few years a new start has been made with a study of the natural population of *X.populi* in Belgium, aiming to gain a clear understanding of the evolution of the pathogenicity of this bacterium in comparison with the virulence and aggressiveness of the reference strain CNBP 2226.

Materials and methods

Since 1983 a collection was composed for Belgium of 80 strains of *X. populi*, isolated from 11 different poplar species, hybrids and clones.

55 of the strains were isolated from the *P.x euramericana* clone "Regenerata", wich has been frequently planted in many Westeuropean countries for nearly two centuries.

The virulence and aggressiveness of these isolates was studied by means of artificial infections on poplar clones with a varying sensitivity to the bacterial strain CNBP 2226.

The method of infection consists of the artificial insertion of the bacterium in a one year old plant and causes, in the spring, small cracks in the bark of sensitive clones, which develop to form a canker later in the growing season.

The reaction of the plant on the infection is studied for 2 consecutive years, after which selection for resistance is possible.

Quotation of the sensitivity of the tested clones is based on girdling index (0 to 5) and the length of the cankers (RIDÉ, 1966).

Results

The results of several infection tests show in the first place large differences in aggressiveness between the different isolates of *X.populi*.

For the clone Boelare, for example, the aggressiveness of the strains varies from a girdling index of 0.1 to 3.0 (see graph 1). The aggressiveness is nevertheless independent of the botanical origin (the poplar species,

hybrid or clone) of the strains nor is it influenced by the geographical origin (= Belgian province) of the strain. Very aggressive strains were isolated from poplars infected with *X. populi* in all Belgian provinces.

Several isolates show a higher aggressiveness than the reference strain CNBP 2226.

Comparisons with earlier performed infection tests proved that, despite the annual re-isolation of the strain, the strain has lost aggressivity significantly since 1987.

A comparison of the aggressiveness of these new isolates with that of strain CNBP 2226 does therefore not permit us to state the evolution of the strains to an eventually higher level of aggressiveness.

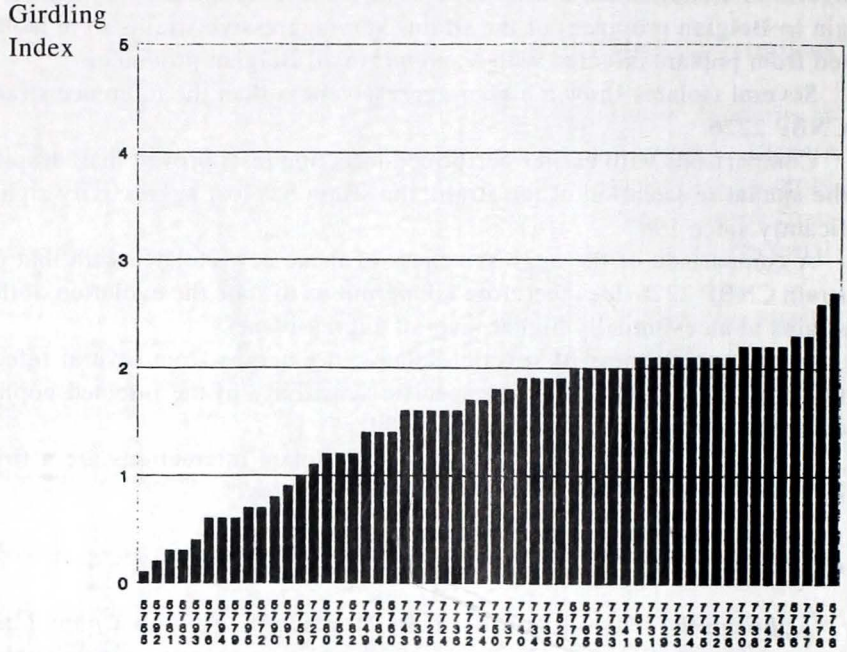
The aggressiveness of several isolates, it emerges from several infections, is also a function of the specific sensitivity of the infected poplar clone to *X. populi* (STEENACKERS, 1989).

The appearance of these specific clone-isolate interactions are a first indication of the existence of races within *X. populi*.

Conclusion

Although the reliability of the artificial infection test with *X.populi* has been proven sufficiently clearly during the past years (not a single poplar clone, selected for high resistance to *X. populi*, was found to be infected in nature not even after 30 years), the future selection of canker resistant clones will have to take place based on artificial infections with 10 selected bacterial strains.

The identification of races within the natural population could simplify the choice of the bacterial strains to be used for the selection of canker resistant clones



Infections : september 1987
Results : september 1988

Fig. 1 - Differential aggressiveness among 54 strains of *X. populi* on the clone Boelare.

2. Resistance to the rusts *Melampsora* sp.

Worldwide, the *Melampsora* sp. rusts are among the most important parasites of poplars.

Serious infections by rust cause early leaf fall, resulting in an early stop of growth and, in addition to this, plants become sensitive to other parasites of stems and branches such as *Dothichiza populea*.

Materials and methods

Identification of rust species is done under the microscope, following a key described by PINON (1973), based on the shape of uredospores and parafyses.

Races are identified by determining their virulence towards several clones. This is done by means of artificial infections with uredospores on rust-free leaves or leaf-disks (STEENACKERS, 1988).

Results

1. *MELAMPSORA LARICI-POPULINA* KLEBAHN

In 1980, Belgium experienced once again a massive die-back of tens of hectares of poplar plantations of the clone "Robusta" caused by a combination of an attack by *M. larici-populina* and an attack by *Dothichiza populea*.

The high infection levels of rust were caused by the rise of a new rust race of *M. larici-populina* (STEENACKERS, 1982 ; PINON *et al.*, 1987).

Presently, in France and Italy, 3 races of *M. larici-populina* have been described (PINON *et al.*, 1989) apart from the old race occuring before 1980.

The different races of *M. larici-populina* (old race, E1, E2and E3) can be determined by means of their specific reactions on the following clones :

Race / Clone	Old Race	E1	E2	E3
Robusta	+	+	+	+
Ogy	–	–	+	–
Unal	–	+	+	+
76.004/10	–	–	–	+

+ = susceptible – = resistant

Until 1980, in Belgium not a single clone, selected by the Poplar Research Centre, (today Institute of Forestry and Game Management) was found to have lost resistance to *M. larici-populina*.

Since 1980 a higher sensitivity to rust was observed on the clone Robusta, while the clones Unal, Hunnegem, Raspalje, Isières and Ogy suddenly became sensitive to rust.

From artificial infections emerged that this breakdown of resistance was not only due to the origin of rust race E2 to which the clones Robusta, Ogy and Isières became sensitive, but moreover to the simultaneous origin of a rust race E1, to which the clone Robusta became sensitive as well, just like the clones Unal, Hunnegem and Raspalje.

Population of rust races in the experimental nursery of the Institute of Forestry and Game Management in Grimminge - 1991

Not on a single clone the old race of *M. larici-populina* was found. Since the origin of the races E1 and E2 in Belgium in 1980, this old race was no longer identified in the experimental nursery.

Before october 1991 race E1 was the main rust race. All rust symptoms, caused by *M.larici-populina*, until the end of september were exclusively due to race E1. The races E2 and E3 were identified for the first time in the middle of october. This explains why clones like Ogy, Isière and 76.004/10 were only slightly attacked by rust at the end of the 1991 growing season.

The rust race E3, which has been present in Italy for some years already, and which has presumably originated among others on the Italian clone Louisa Avanzo, was observed for the first time in our nursery on the clone 76.004/10 in 1987. Since then, the race E3 was observed each year in the nursery (see table 1).

The clones Robusta, Hunnegem, Raspalje and Unal, which are sensitive to race E1, are also sensitive to race E3.

The appearance of race E3 in Belgium since 1987 has, however, had no significant influence on the rust attacks of these clones in plantations.

2.*MELAMPSORA ALLII-POPULINA* KLEBAHN

Although in the literature (HENNEBERT, 1964) *M.allii-populina* has been mentioned in Belgium, its presence was never demonstrated before.

In 1986 we stated *M.allii-populina* for the first time in a plantation in Tournai on the clones Boelare, Beaupré and Ghoy.

Since then we have identified this rust species also in plantations in the provinces of East-Flanders, Brabant, Limburg, Namur and Luxembourg.

In 1987 we identified *M.allii-populina* for the first time in the experimental nursery of the Institute of Forestry and Game Management in Grimminge (Geraardsbergen) and this on several hundreds of clones. The attacks by *M.allii-populina* are nevertheless less intense than those caused by *M. larici-populina*, and don't influence the growth of the clones at all (see table 1).

Infections by *M.allii-populina* are nevertheless important in the Gaume region (south of Belgium).

Here we stated the presence of this rust species on several clones in experimental plantations in Lamorteau and Robelmont (see table 2).

The higher infection levels obtained in the Gaume region for *M.allii-populina* can probably be explained by the specific microclimate of this region, where a high humidity of the air in the morning and a milder climate during the day favour the development of the uredospores of *M.allii-populina*.

For this region it will be necessary in the future to select clones which have a sufficiently high resistance to both rust species at the same time.

On May 15th 1991 in a nursery near Tournai, attacks by *M.allii-populina* were recorded on the clones Boelare and Beaupré. This exceptionally early infection could be explained by the presence of a 2 ha large field of *Allium*

ursinum, one of the secondary hosts of *M.allii-populina*, next to the nursery.

The rust symptoms on the Allium could, through artificial infections on poplar, be identified as aecidia of *M.allii-populina*.

TABLE 1

Rust attacks in the nursery of the Institute of Forestry and Game Management (Grimminge).

Clone \ Year	1983	1984	1985	1986	1987	1988	1989	1990	1991
69.039/4	0	0	0	0	1	1	1	1	1*
71.009/1	0	0	0	0	1	1	1	1	1*
71.009/2	0	0	0	0	1	1	1	1	1*
71.015/1	0	0	0	0	1	1	1	1	1*
75.016/5	0	0	0	0	1	1	1	1	1*
S.681-84	0	0	0	0	1	1	1	1	1*
S.683-24	0	0	0	0	1	1	1	1	1*
76.004/10	0	0	0	0	3	3	3	3	1**

Scoring system : 0 (= free of rust) to 5 (heavily infected)

* infections by *M.allii-populina*

** infections by *M. larici-populina*

TABLE 2

Infections by *M.allii-populina* in the Gaume region.

clone	Nursery Robelmont october 1990	Nursery Robelmont october 1991	Plantation Lamorteau october 1991
71.015/1	2.0	1.0	
71.009/1	2.5	1.0	
71.009/2	2.5	1.0	
69.038/1	2.0	1.0	
69.038/6	2.0	1.0	
Boelare	1.5	1.0	2.0
Beaupré			2.0

Scoring system : 0 (=free of rust) to 5 (heavily infected)

Conclusion

The rust species *M.allii-populina* has, so far, for the largest part of Belgium no negative influence on the growth of poplars.

For the south of Belgium (the Gaume Region), however, this species has to be taken into account.

This selection for resistance to *M.allii-populina* is not possible using the observations in the nursery of the Institute, and should be carried out through observations of natural infections in the Gaume Region, completed with artificial infections in the lab.

Samenvatting

PHYTOSANITAIRE TOESTAND VAN DE POPULIEREN IN BELGIE IN 1991

Een samenvattend overzicht wordt gegeven van het lopende onderzoek met betrekking tot de belangrijkste populierenziekten zoals *Melampsora* sp. en *Xanthomonas populi*.

Voor *Xanthomonas populi* werden over het ganse Belgische grondgebied in totaal 80 isolaten verzameld en systematisch op virulentie en agressiviteit vergeleken. De op punt gestelde kunstmatige infectietechniek blijkt uiterst efficiënt en betrouwbaar te zijn en dit eveneens na vele jaren, zodat besloten mag worden dat de voor vele klonen bestaande resistentie niet doorbroken werd.

Melampsora larici-populina blijkt in België duidelijk frequent voor te komen en kan een grote invloed hebben op de groei van gevoelige klonen. De aanwezigheid van meerdere fysiologische rassen werd vastgesteld alsmede de specifieke gevoeligheid van enkele klonen aan de onderscheiden rassen.

Melampsora allii-populina, alhoewel aanwezig, blijkt minder invloed te hebben op de groei van de plant.

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