ACTA BOTANICA HORTI
BUCURESTIENSIS
1970—1971
BUCUREȘTI 1972

BIOLOGICAL PARTICULARITIES OF THE BACTERIA PSEUDOMONAS MORSPRUNORUM AND PSEUDOMONAS SYRINGAE ON THE STONE-FRUIT TREES OF ROMANIA

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Pseudomonas morsprunorum Wormald and *Ps. syringae* van Hall attack the stone-fruit trees of different countries of the world inducing generally identical symptoms (J. E. CROSSE, 1966), manifested by a „summer phase" which consists of spotting and shot-holing of leaves, and by a „winter phase" with branch necroses followed by abundant outflows of gums and finally with bacterial cankers. On these branches the buds formed are destroyed in different phases and few remain viable.

In the case of the development of the complete cycle of disease the attack of bacteria has the following evolution : in necrotic branches the bacteria which over wintered multiply intensely in spring, and come out through cankers produced on account of the irregular growth of bark, thus constituting the main source of inoculum. Infections on leaves throughout the vegetation period ensure secondary infections either on extension shoots or later on bark by the lesions which remain following the fall of leaves.

In England, California, New Zealand, France, the canker phase is dominant inducing serious affections, which can lead to massive wiltings of stone-fruit trees, often ending with the death of the entire tree (J. E. CROSSE, 1966).

In California the canker phase has two maxima, in autumn and in spring, while in summer the pathogenic agent survives in the infected cortical tissues (E. E. WILSON, 1936). In England the pathogenic agents from infected bark, due to a climate without extremes, have a continous but slow evolution, while cankers occur only in spring, likewise when the bacteria migrate rapidly into tissues.

In Italy the canker phase is present particulary at the level of nodes and fruiting spurs, while the stem and bifurcation cankers have a smaller incidence (G. L. ERCOLANI, 1966).

In Jugoslavia the canker phase induced by *Ps. morsprunorum* was not recorded (M. JOSIFOVIĆ and D. SUTIĆ, 1964).

In Romania, I. LAZĂR (1964) describes the bacterium *Ps. morsprunorum* as a shot-holing agent of plum leaves in the districts of Argeș and Hunedoara, mentioning that he failed to find the canker phase, though he does not consider it as excluded.

In a previous work we (1968) confirmed the existence of the bacterium *Ps. morsprunorum*, showing that, beside this, on the stone-fruit trees of Romania, *Ps. syringae* is likewise to be found, which was previously known only on pear and apple trees (EL. BUCUR and I. LAZĂR, 1960), and is recognized in literature as a very polyvorous agent (GH. ELLIOTT, 1951).

Taking into account the variable manifestation of these two pathogenic agents in different countries of the world, and trying to elucidate their particularities in Romania, we investigated the correlation between the climatic conditions and the biology of the two pathogenic agents, *Ps. morsprunorum* and *Ps. syringae*.

Material and methods

We examined the manifestation and the relative incidence of the pathogenic agents on the stone-fruit trees of our country for three years, between the years 1967—1969. For this purpose more than 150 samples of branches with cankers, suspect of being induced by the two agents, were collected from all the fruit-growing regions and we isolated the bacteria and identified them on the basis of a biochemical rapid testing technique recommended in literature (J. E. CROSSE, 1959 ; C. M. E. GARRETT, C. G. PANAGOPULOS and J. E. CROSSE, 1966), as well as of certain serological reactions of agglutination on slide.

The evolution of the climatic factors taken into consideration was followed out on the basis of data put at our disposal by the meteorological Institute of Bucharest.

Results

On the arrival of spring, in each of the 3 years under consideration, we found on the branches of numerous stone-fruit trees (plum, apricot, morello, cherry, peach trees) elongated necroses along the branches, of a dark-brown aspect, slightly sunk in relation to the bark level, or bark lesions accompanied by abundant gom outflows. When the tree begins vegetation, part of the buds no longer develop and become necrotic or overrun by gums, others begin vegetation, but soon wilt, while some others can develop normally. All these categories can alternate on the same branch.

The numerous attempts to isolate the two pathogenic agents of these wounds remained unsuccessful, yellow bacterial colonies or different species of fungi were obtained, and many times, nothing was isolated from the necrotic or cankerous regions. Only in a few cases could the two pathogenic agents be isolated.

Discussions and conclusions

The results obtained determined us to consider that the phase of canker induced by bacteria *Ps. morsprunorum* and *Ps. syringae* is not widely spread in Romania.

The fact that neither I. LAZĂR (1964) nor ourselves could ascertain the positive existence on stone-fruit trees of cankers induced by the pathogenic bacteria of the genus *Pseudomonas*, as well as the fact that neither in Yugoslavia has this phase been observed (M. JOSIFOVIĆ and D. SUTIĆ, 1964), made us investigate a climatic relationship between the regions where this symptom is marked and others where it is less so. For this purpose we used a physico-geographical atlas of the world (Atlas mira, 1964). The climatic study of the regions considered — California, England, New Zealand, some regions of Italy and France, etc. — shows that in these regions winters are fairly mild, the average monthly temperature being above +5°C in the fruit-growing regions of England, and above +10°C in California. This means that in these regions the bacteria which had infected autumn, in different ways, the bark, can multiply in cortical tissues and lead to their invasion which induces the necrosis of the respective region and apparition of cankers.

Though the data of the above mentioned atlas are recorded in average monthly values, hindering us in following out the evolution of meteorological factors on shorter intervals we consider that the existence of the two maxima of the canker phase of California is due to the setting in of a colder period in the middle of winter, a phenomenon which divides into two the evolution of the canker phase. In England the more uniform evolution of the climate can ensure a slow but continous incubation of bacteria in the bark with the breaking out, in early spring, of the open canker phase.

The fact is noteworthy that all the regions in which the canker phase is dangerous are situated in zones with a maritime climate in which winters are not too cold and too low thermic minima are not recorded.

In Romania, the average monthly winter temperatures frequently fall to below —5°C, which means a difference of about 10°C. Thus, in the winter of 1966—1967, in January, the average monthly temperature was of —6,5° at Suceava, of —4°C at Voinești, —8,2°C at Brașov, and of —4,2°C in Bucharest.

Table 1 presents the evolution of the average monthly temperature of the winter of 1967—1968 in 10 localities, around which there are important fruit-growing areas.

Table 1

EVOLUTION OF THE AVERAGE MONTHLY TEMPERATURES IN THE WINTER OF 1967—1968

Locality	Months					
	XI	XII	I	II	III	IV
Cluj	4.3	—2.0	—5.3	0.9	4.0	12.1
Suceava	4.7	—2.4	—5.2	0.7	1.6	10.9
Brașov	3.5	—2.2	—5.2	—0.5	2.4	11.3
Baia Mare	5.6	—0.2	—4.9	2.0	4.6	12.7
Iași	6.0	—1.4	—4.7	—0.7	3.3	13.1
Voinești	5.3	—0.9	—3.4	1.5	3.4	12.0
Oradea	5.9	—0.4	—3.2	3.2	5.3	13.3
Buzău	6.8	0.3	2.2	1.6	4.6	13.8
Craiova	6.3	—0.1	—2.0	2.2	5.3	14.0
București	9.3	0.4	—1.9	2.6	5.5	15.0

The winter of 1968—1969 was still colder, lower temperatures being recorded. În Bucharest, for instance, the average temperature for the month of January 1966 was of — 5,8°C. Such average temperatures imply thermic minima of —15°C or even —20°C, which impede or render the evolution of bacteria in the cortical tissue difficult during winter, even if they succeeded during autumn, in infecting in some way the bark.

So far, it appears evident that in our country the evolution of the disease would have the following cycle : the few viable centers of bacteria of the bark or of the incipient cankers or of buds constitute in spring a slight initial inoculum for young leaves. In our country strong foliar infections are therefore to be expected somewhat later. By its multiplication throughout the vegetation season, on green organe, the bacteria come to penetrate in autumn into the bark, creating there infection. Winter climatic conditions diminish, however, the number of these focuses or impede their evolution. Milder winters, with slightly lower temperatures might lead to the favouring or these infection focuses, having as final effect necrosis and bark canker.

Our conclusions concerning the parallelism between the evolution of disease and the climatic factors correspond to certain observations from literature. Thus J. E. CROSSE (1954) finds that the evolution of the disease induced by *Ps. morsprunorum* in England is favoured by a moist and cool climate while H. BORTELS and G. GEHRING (1960) in Germany, assume the influence of several factors among which they certainly include temperature and moisture. H. G. HEPTING (1963) dealing with the importance of climate in phytopathology, considers that an important role should be allotted to temperature, precipitations, moisture, fog and dew water, as well as to wind and solar radiation.

Besides the climatic factor, N. SHANMUGANATHAN (1962) records the setting in during summer of a seasonal resistance to infection of the cortical tissue.

Considering that the canker symptom can be produced by a large number of pathogenic or non-infectious agents, the only conclusive test for the exact elucidation of the problem discussed would be the production of experimental infections in conditions controlled under climatic aspect.

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