

NEWS AND OPINION

Towards a redefinition of the diseases within the esca complex of grapevine

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Summary. This article proposes a new definition of the concept of esca of grapevine, and of the diseases associated with esca. A proposal is made to restrict the term “esca” to grapevine wood rot, as in the past, and to apply the name “Grapevine leaf stripe disease” for the tracheomycosis which is the conspicuous and familiar visible tiger stripe symptoms on grapevine leaves. Retention of the term “esca proper”, to designate the co-occurrence of esca and Grapevine leaf stripe diseases, will retain linkage with the early terminology and with the convention of associating tiger striped leaves with wood rot.

Keywords: Grapevine leaf stripe disease, Phaeotracheomycosis complex.

Introduction

The conceptual process of individualising and/or illustrating the essential properties of a given object or phenomenon is normally called “definition”. A good and complete definition often helps one to grasp a concept more quickly. A term or word on the other hand is normally defined as the oral or written expression of a concept or information, that is the representation of an idea. In scientific disciplines such as plant pathology, terms and definitions are of fundamental importance, not only to describe biological phenomena, but also to objectively formulate ideas. Some examples of terms frequently used loosely in plant pathology are “pathogenicity” and “virulence”, “isolate” and “strain”, “disease tolerance” and “disease resistance”, “disease cycle” and “pathogen life cycle”.

In the case of esca of grapevine, there has a progressive evolution in the comprehension of the disease. This has resulted in different names and definitions proposed for the syndromes into which the disease has been fragmented. There is an urgent need for a new definition of the concept of esca and of the associated diseases of grapevine.

When apoplexy (or folletage) was the name given to esca

The first scientific studies on esca were all carried out in France, where the disease was initially known as apoplexy or folletage. Vines suffering from this disease suddenly withered, *without premonitory signs*, and generally did not resume growth in a subsequent growing season (Rolland, 1873; Ravaz, 1898, 1901, 1907, 1909; Vinet, 1909, 1910; Viala, 1922).

Ravaz seems to have been the first to realise, in 1905-06, that a disease having the same symptoms as folletage was already known in the region of Smyrna, which at the time still had a large Greek

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population. This disease was called “iska” by Smyrna wine growers (Parlou, 1906). At the same time or somewhat later, the French botanist and plant pathologist Pierre Viala was informed by a friend, Monsieur Lemarchand, who owned and ran a vineyard near Squinzano in the Italian Province of Lecce, that in that part of Italy the disease folletage also existed, but that it was there named “esca”. As a result of these acquisitions, from Smyrna and from southern Italy, Viala proposed that the grapevine disease known as folletage, or apoplexy, should be given the name “esca”.

The term esca derives from the Latin, whereas iska is Greek in origin. In Latin, esca has two basic meanings, “food”, and “bait”; later it came to signify the inflammable material used to kindle a fire, “tinder”. Iska, on the other hand, meant also “fungus”. Elio Montanari, a linguist of the University of Florence, reached the conclusion that the Greek iska (with its original meaning of epyphitic fungus and, when dried, tinder) was taken over by Latin with yet another meaning: that of “aliment of fire”, and also, indirectly, that of fungus (in Surico, 2008). Rotted wood used like the dried fungus to kindle a fire was also called esca. Viewed historically, therefore, esca was the rotted wood, and was also the name given by wine growers to a disease of grapevine. Since the rotted wood inside the vine could not be seen, apoplexy was taken to be the visible symptom of this disease.

The leaf symptoms of esca

In 1926 Viala listed a number of foliar symptoms that he claimed were also associated with esca. One of these symptoms was the tiger stripes (Fig.1). Many of these different leaf symptoms alleged by Viala to indicate esca would in time be abandoned. An example was the symptom he termed *résorption*, which indicated leaves that were diaphanous, almost transparent, and that had their veins abnormally close together. Other examples are the symptoms not of esca but of some other disease, such as eutypiosis, leaf roll, or fanleaf. Thus all Viala’s alleged foliar symptoms of esca were in time reassigned to other diseases, and in the end only the tiger stripes remain as symptoms indicative of esca (Fig. 2). Tiger stripe symptoms were originally taken as indicating a light form of esca, and thereafter as the chronic form of the disease, as opposed to apoplexy, which was the acute form.

The symptomatology of esca that eventually be-



Fig. 1. Depiction of tiger striped leaves of grapevine in Viala, 1926.

came accepted as indicative of the disease (wood rot, apoplexy, chlorosis and necrosis of the leaves) was therefore determined by gradually reducing a superfluity of initial proposed symptoms, rather than by attempting experimental determination of the causes of those symptoms.

The esca complex

A second, more recent wave of studies on esca, dating from the late 1980s to about 2000, has led to better understanding of both the internal symptoms of esca and aetiology of the disease. Two new

fungal genera, *Phaeoacremonium* and *Phaeomoniella* (Crous *et al.*, 1996; Crous and Gams, 2000), have been established, comprising those fungi that apparently cause the vascular symptoms of esca (in particular *Pm. aleophilum* and *Pa. chlamydospora*). On the other hand, the main agent that causes wood rot of grapevine has been determined as the basidiomycete *Fomitiporia mediterranea* (Fischer, 2002). It has been realised that esca is in fact a rather different disease from what the early researchers had thought. At the first International Workshop on esca of grapevine, held at Siena in 1999, the culmination of a decade of research work on esca led to the formulation of new hypotheses on what the disease was or could be (Graniti *et al.*, 2000). It was either:

A. a complex disease, in the sense that a number of interacting factors and various micro-organisms acting together determined the whole syndrome of esca, or B. a complex of five distinct syndromes:

1. dark wood streaking, seen especially in the rootstock of grafted cuttings;
2. Petri disease, formerly also known variously as “black goo”, “slow dieback”, “*Phaeoacremonium* grapevine decline”, and affecting young vines (2–7 years);
3. young esca;
4. white rot;
5. esca proper.

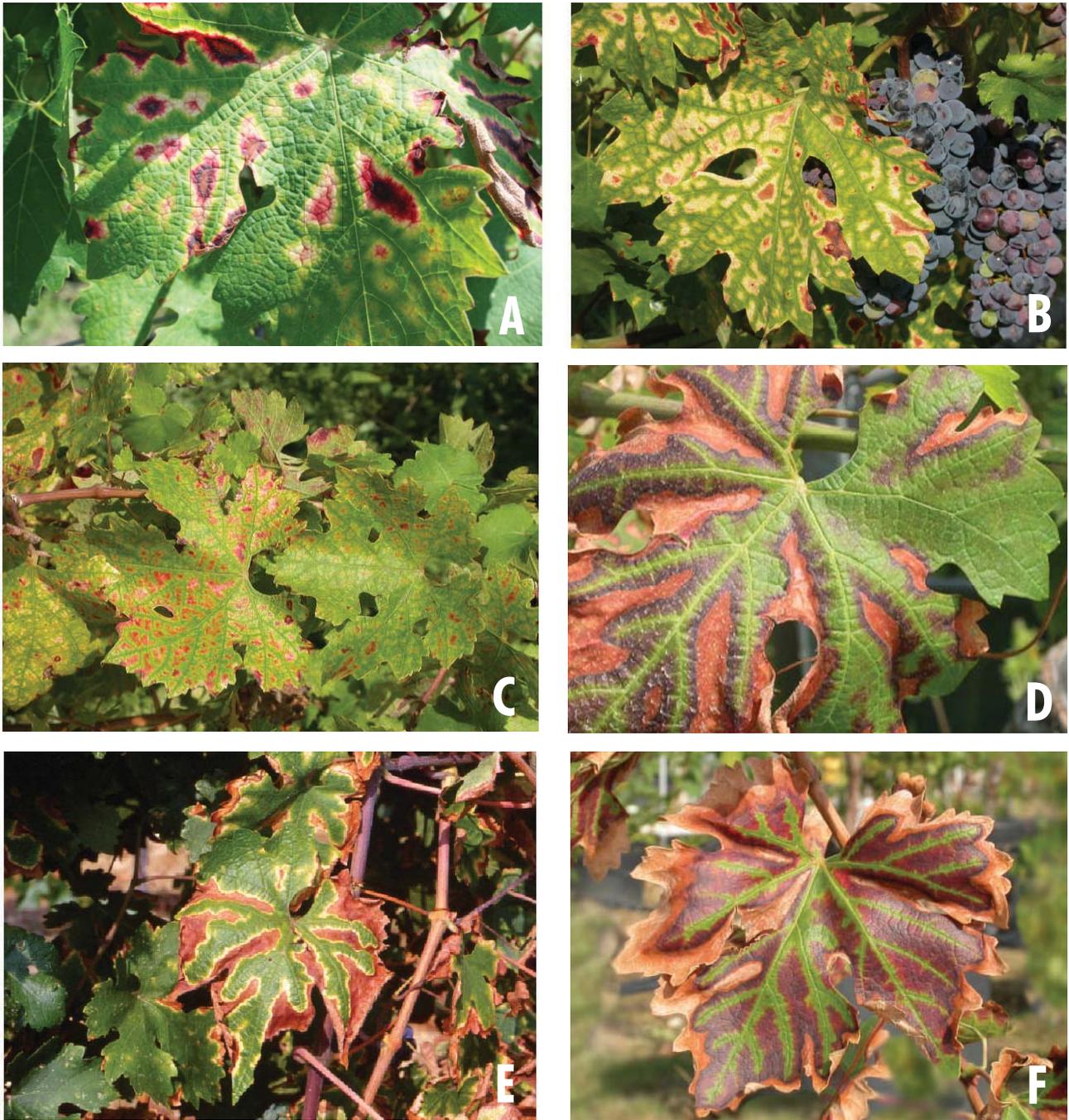


Fig. 2. Some examples of the initial (A–C) and final (D–F) lesion stages associated with ‘grapevine leaf stripe disease’.

Plant pathologists have accepted this subdivision of esca into five syndromes.

The first three diseases making up the esca complex all have the same biological cause (infections by *Pa. chlamydospora* and/or *Pm. aleophilum* or occasionally another species of *Phaeoacremonium*). They differ in that they infect vines of different ages (rooted cuttings, or young vines), that some of their wood symptoms are different, and that they also produce different leaf symptoms (at least in the case of Petri disease and young esca, the former causing diffuse chlorosis, the latter causing the tiger striped leaves). We are therefore faced here with a single cause producing three different responses in grapevine.

The fourth disease, white rot, has distinct causal agents, different basidiomycetes species represented mainly by *F. mediterranea* in Europe and the Mediterranean basin, and producing its own characteristic inner white rot symptom, with no known external symptoms.

The fifth disease, esca proper, is merely the co-occurrence of two existing syndromes in the complex, young esca and white rot, and vines affected with this disease exhibit symptoms of both those syndromes.

Even apart from the uncertainties that still exist about whether one or other of these fungi causes the disease process, or whether they act in combination with each other, or only when favoured by particular physiological states of the vines or by particular environmental factors, some of these disease names, are not altogether suitable. This is particularly the case for “young esca” and “esca proper”. At the time when the names were proposed, it was important to distinguish between, on the one hand, vines infected with the tracheomycotic fungi *Pa. chlamydospora* and *Pm. aleophilum*, both producing brown wood streaking, and chlorosis and necrosis (“tiger stripe”) on the leaves, and, on the other hand, vines infected with these two fungi plus the white rot fungus *F. mediterranea*. These two syndromes, were named “young esca” and “esca proper” respectively (see above).

It was decided to adopt the term “young esca” for three main reasons (Graniti *et al.*, 2000):

1. infections with *Pa. chlamydospora* and *Pm. aleophilum* normally (though not always) preceded infections with *F. mediterranea*. (Infections of rooted cuttings with *Pa. chlamydospora* and *Pm. aleophilum* were examples of this.);

2. the hypothesis advanced by Larignon and Dubos (1987) that *Pa. chlamydospora* and *Pm. aleophilum* were pioneer fungi causing wood rot had not yet been definitively disproved; and above all,

3. Petri, who was the first to diagnose *Pa. chlamydospora* and *Pm. aleophilum* in young vines (1912), assumed that these fungi also predisposed vines to wood rot, caused by *F. mediterranea*, which arose more slowly and gradually. (Therefore, the term “esca proper” was intended to signify that young esca slowly evolved into a “complete” form of esca, in which all three causal fungi co-occurred: the first two causing the tracheomycosis, and the third, causing white rot).

Of these three reasons to view “young esca” and “esca proper” as distinct syndromes, perhaps only one still has some validity. *Pa. chlamydospora* and *Pm. aleophilum* infections can indeed appear very early, but then again, so can *F. mediterranea*.

While these three fungi can interact with each other (Sparapano *et al.*, 2000a), such interactions are not necessary to produce any of the diseases in question. Each fungus can also act as a primary pathogen (Sparapano *et al.* 2000b, 2001). It is therefore no longer relevant to accept that one disease gradually evolves into another, or that one infection necessarily precedes the other. We now know that whenever the three fungi occur in the same environment, sooner or later they will be found to co-occur on the same vine. Mature vineyards in the Mediterranean region are most commonly affected both by tracheomycosis and white rot.

Nevertheless, quite apart from these considerations regarding sequential occurrence or co-occurrence, the inappropriate nature of the classification adopted in 2000 seems clear today. At that time the same, or nearly the same, name was given to two diseases whose causes and symptoms are very different: “young esca”, which is a tracheomycosis, and “esca proper”, which is a combination of young esca and white rot of vinewood. Furthermore, the name “white rot” was then given to what had traditionally always been called “esca”, and the name esca was transferred to the tracheomycosis, a previously unknown condition.

Proposal for new names

What suggestions can be offered to remedy these unsatisfactory names that were given to some of these syndromes of esca?

One suggestion is simply that to abandon the group-term “esca complex” altogether, to consider each disease in its own right, and to return to using “esca” with its original meaning of white rot. In that case the disease characterised by the tiger stripes on the leaves (which most likely has nothing to do with white rot) would have to be given its own name. We then would have the following scheme for these diseases of grapevine:

Brown wood streaking (mostly affecting rooted cuttings), Petri disease, Grapevine leaf stripe disease (previously “young esca”), and Esca (synonym of white rot).

To underline the fact that three different diseases (Brown wood streaking, Petri disease and Grapevine leaf stripe disease) are caused by the same fungi (*Pa. chlamydospora* and/or *Pm. aleophilum*) on the same host plant (a fact that still requires study), these diseases may be grouped in a single disease complex that could be called the “Grapevine Phaeotracheomycosis complex”. This classification reflects the current state of our knowledge and but still has a defect: it upsets the century-old notion that the tiger stripes on the leaves are a symptom of esca (Fig. 2). Nevertheless, this defect can be obviated if the term “esca proper” (that is Esca *sensu* Viala) is retained. The distinct name would underscore that, at least in those countries where both esca and tiger striped leaves are found, this particular co-occurrence is very common in grapevines.

Conclusions

Viala (1926) imagined how the popular term “esca” came to be applied to the disease as follows:

“When vines are inspected, there is no outward sign of disease for the first few years. Only if an apoplectic vine trunk is cut open along its length, years later, does a mass of rotted wood reveal the presence of the disease. Therefore, it not infrequently happened that bulky and fully-grown vines died suddenly and were destined for firewood, and not till they were cut into pieces did they reveal to wine-growers that the wood had been rotted all along”.

Long ago, wine growers began to say that their vines “had esca” when they meant that the wood of those vines was rotted, and was good only to kindle

fires, or as firewood. They assumed that it was the wood rot that caused sudden death of vines, which was not unreasonable in view of the severe damage that can result from vine wood rotting. That the wood rot caused esca was accepted by early French researchers, who concluded that wood rot also caused leaf symptoms. This was without ever succeeding in artificially reproducing either the apoplexy or the leaf symptoms – which still remains to be achieved.

We know, within the limitations mentioned above, that facts relating to these diseases are different. For one thing, it is almost certain that the tiger striped leaves are not caused by *F. mediterranea*. In countries such as Australia, though wood rot occurs commonly in vines, tiger-stripe leaf symptoms are rare. And yet, although two clearly defined new diseases (dark wood streaking of rooted cuttings and Petri disease) have been identified, the term esca has continued to be used as a convenient single name to denote some dramatic symptoms (wood rot, the leaf symptoms, and apoplexy) in grapevine, but that differ from each other.

To conclude, a new element of reflection is offered.

The foliar symptoms of esca, the tiger striped leaves, have only been recognised since about the 1920s. Even when Newton B. Pierce came to France and Italy in the late 1880s on behalf of the US Department of Agriculture, to investigate a grapevine disease similar to that which was later named Pierce disease (the symptoms of Pierce disease resemble those of esca) he did not mention “leaf symptoms of esca” in his reports, published in 1889 and 1892. It is hard to accept that Pierce or his associates failed to notice such conspicuous symptoms during the 5 months of his stay in Europe. His lack of record of these symptoms could have been due to one or more of several factors. First, foliar symptoms at the time were so rare that they never came to his attention (this seems unlikely). Second, none of his informants had been interested in them (also very unlikely). Third, the foliar symptoms of esca did not occur until some time after his visit (this too is highly unlikely). Fourth, Pierce did not find any foliar symptom because no such symptoms existed at the time. This last could be because the foliar symptoms that would later be claimed to be indicative of esca were not caused by esca *sensu* Viala at all, but by

some quite different disease introduced at a later date. Here a recorded episode may be instructive: on 18 October, 1890, B.T. Galloway, Head of the Division of Vegetable Physiology and Pathology and Woods of the US Department of Agriculture, after receiving a number of reports of a new grapevine disease in various parts of New York State, especially around Lockport, Niagara County, sent his assistant D.G. Fairchild to investigate. After seven days he reported (in Galloway and Fairchild, 1891) “small irregular blotches of dark color appear between the veins, these enlarge rapidly, darken to a dull purplish or reddish-brown, and coalesce so as to fill up the space between the veins, which remain green or yellow. These changes occur so rapidly that the foliage seems to change color suddenly. The contrast between the green or light-yellow veins, and the dark purplish brown of the intervening tissues (see Fig. 2, upper, right and left) gives a peculiar *streaked appearance* to the leaves”. These observations probably refer to the tiger striped leaves of esca, but they were written more than 30 years before Viala first reported tiger stripe symptoms as esca symptoms in France in 1926.

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Accepted for publication: March 2, 2009