Letter to the Editor

Nomenclature for Pathogenicity and Virulence: Precision vs. Tradition

D. Andrivon

INRA, Plant Pathology Station, Domaine de la Motte, BP 29, F-35650 Le Rheu, France.
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In a recent reply to my letter on the nomenclature of pathogenicity-related terms (1), Hunt (3) objected to several definitions I proposed or backed, and advocated "sticking to definitions of terms and understanding of concepts that originated deep within our academic family tree." However, Hunt missed several important points, making his position difficult to accept.

The need for clear definitions. While himself stressing the pivotal importance of disease for the definition of pathogenicity-related terms, Hunt (3) failed to define precisely what a disease is, arguing that "plant pathologists understand the concept of plant disease and can accommodate slight variants in its definition" simply because disease is an old concept (3). In my view, the antiquity of a concept is not a valid criterion to assess the accuracy and relevance of its definition, and an even less valid argument to simply negate the need for defining it explicitly. Hunt's insistence that "terminology should be used properly" (3) obviously requires that definitions of terms and concepts are agreed upon, which in turn requires that they are stated precisely.

Traditional or recent definitions? Hunt's main point is that traditional definitions should always be used and preferred over more recent ones, because they are familiar and were proposed by respected authorities. There is no doubt that some long-standing definitions are still of value today and should continue to be used. This is the case with Whetzel's definition of pathogenicity as "the ability of an organism [pathogen] to produce disease" (12). Contrary to Hunt's (3) statement that I failed to define pathogenicity, my definition of a nonpathogen as "an organism not inducing disease when challenging another" (1) is nothing than another, more precise wording for Whetzel's definition of pathogenicity. However, sticking to traditional definitions that no longer accurately reflect ideas, concepts, or knowledge is likely to increase confusion rather than avoid it, as a brief discussion of two examples from Hunt's letter will show.

Hunt stated that "all well-trained plant pathologists should use only [Whetzel's (12)] original definition for virulence—[i.e., to designate] 'the measure of pathogenicity' " (3), whereas I supported using the later definition by Vanderplank. Whetzel's definition of virulence is still in use in animal and human pathology (4), and its use could therefore be recommended in order to avoid misunderstandings between animal and plant pathologists. However, I think Whetzel's definition has two major drawbacks that are avoided in Vanderplank's. First, Whetzel's definition could well have been spared: pathogens can be described just as conveniently as more or less pathogenic (as is often done) rather than as more or less virulent, if virulence is only a measure of pathogenicity. Second, and more importantly, Whetzel's definition of virulence does not allow for the separation between the qualitative (virulence sensu Vanderplank [8,9]) and quantitative (aggressiveness in Vanderplank's [8,9] terms) components of pathogenicity. This separation is not only "to satisfy a geneticist's need for paired terminology," as claimed by Hunt (3). Genetic and mechanistic evidence is accumulating to show that virulence sensu Vanderplank is a consequence of recognition (or the lack of it) between interacting organisms, while aggressiveness is related to the ability and efficiency of a pathogen to use its host as a substrate (6). Evidence also exists that the two components are, at least in some cases, governed by different genetic mechanisms (as was shown for instance for uredial size and virulence in *Puccinia recondita* [7], or for sporulation capacity, lesion length, and virulence in *Cochliobolus carbonum* [11]). Furthermore, virulence and aggressiveness (sensu Vanderplank) have very dissimilar epidemiological consequences (8), an observation that is of relevance to both the pathologist and the geneticist. All of these facts support using separate denominations for qualitative and quantitative components of pathogenicity.

The case of virulence is a prime example for the lack of precision of some of the definitions Hunt recommends sticking to, leading to potential confusion and contradictions. Using Walker's definition of a pathogen as "an agency which incites disease" (10), Hunt (3) argued that "a pathogen is a pathogen at all times," irrespective of the host. As he admits that the interaction of *Phytophthora infestans* with pines produces nothing that can be equated to disease, Hunt's terminology leads to calling *P. infestans* on pines a nonpathogenic pathogen. This contradiction is easily overcome by the separation between nonpathogens and avirulent pathogens, using Vanderplank's definitions. As shown by Hunt himself in his discussion of avirulence (3), sticking to traditional definitions is no guarantee of unambiguous use of terms. In the present case, part of the confusion comes from Hunt mistaking my definition of virulence for Whetzel's definition of pathogenicity. Because disease is mainly identified and recognized by symptoms, there is little doubt that hypersensitive necroses are a sign of disease, and hence of pathogenicity of the challenging partner. However, as the pathogen fails to get established, its interaction with the host is not compatible, justifying the "avirulent pathogen" denomination, which indicates that the pathogen is able to cause disease but not to infect successfully this particular host. As discussed above, and as was very clearly outlined and discussed by Loegering (5) in his classic review of interorganismal genetics and of the aegricorpus concept, pathogenicity and virulence are obviously applicable only to pairs of interacting organisms and are not intrinsic features of one of the two partners. This is also true, of course, for the terminology of resistance.

Regularly updating our terminology: A possible solution to a long-lasting debate. "Saving our terminology from bastardization" (3) may be a legitimate goal, but the method Hunt proposed to reach it is hopeless, because it overlooks the fact that science is a dynamic process aimed at increasing our knowledge, refining

our concepts, and improving our understanding of the phenomena we investigate. Baker (2) once noted that "studies often displace previous facts and relegate them to the historic scrap pile." This is also true for concepts and, hence, for definitions. Many traditional definitions were adequate at the time they were coined but are no longer precise enough, because the actual complexity of the phenomena and concepts they described had not yet been unveiled. Sticking to them only because they were proposed a long time ago cannot be justified. Communication in science is meant to transmit unaltered all the information to every person to whom it is of relevance; precision is therefore vital, even at the expense of the familiar, but outdated, definitions of the pioneers.

A more efficient way to achieve Hunt's goal might be the production and periodic update of a dictionary indicating recommended definitions of terms used in plant pathology, mirroring the recommendations periodically issued by international committees in other fields of science, such as taxonomy. This could only be successful if this dictionary is produced by an international organization representative of plant pathologists worldwide, for instance an ISPP Committee focusing on terminology. The current debate, only the most recent in a long tradition of nomenclature disputes, clearly shows that we lack such a reference document, which an international society is in the best position to produce.

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