A Century of Pure Cultures of Plant Pathogens

Importance of isolation techniques formulated in the medical profession during the last half of the 19th century, and quickly adopted by plant pathologists, cannot be overemphasized. My letter is intended to recall how basic, though recent, is our association with a simple procedure (pure culture) of such profound consequences to the profession. It is significant that some of the best thinkers in the world went from spontaneous generation to dogma of constancy of species following Koch's contributions in the 1880s.

Some significant groups of plant pathogens (e.g., viruses, nematodes) are not yet cultured in artificial media and thus are not subject to the classic rules of proof proposed by Koch in 1882. In view of the fact that these rules are standardized and so widely accepted as a criterion for establishing pathogenicity, our concept of "pure cultures" is fundamental. Pure cultures apparently are rare in nature, and a variety of symptom modifications accompany natural infections as saprophytes invariably occupy diseased as well as healthy plant tissue. Seldom are pathogenicity tests made on sterile host plants; nevertheless, they usually allow the plant pathologist to designate those microorganisms inherently capable of initiating destructive processes in vivo.

The valid pathogenicity test, employing use of a pure culture, may be no simple task and has led researchers into grave errors of interpretation. Early on, J. C. Arthur first made use of pure cultures and Koch's methods to establish beyond any doubt that fire blight was caused by a specific bacterium—a task that Burrill did not perform even though he could have greatly embellished his observations had he used this important technique when it became available. This elegant work of Arthur was presented as a thesis at Cornell, and he was awarded the first Ph.D. in science conferred by that institution. Even so, Arthur went on to describe two "bacterial" diseases, one of which was later shown to be caused by a virus and the other by aphid feeding. Several plant pathologists in the mid-20th century claimed that many bacterial plant pathogens had wide host ranges because many produced "symptoms" upon introduction of pure cultures into unnatural hosts. We know now that great care must be taken to establish whether or not these bacteria are pathogenic in the natural environment and that they can incite consistent and persistent disease when introduced at a low dose.

By now, the dynamics of genetic change being what we know it is today, "pure" cultures might be considered almost academic, since we encourage change by maintaining cultures on a wide variety of "media." The ebb and flow of extremism—so common to the history of man—did not escape the scientists who first cultured important plant and animal pathogens. For about half a century after Koch, pure cultures were dogmatically considered invariable; variants cropping up were thought to arise from poor techniques connected with either origin or maintenance of the culture. By now we possess a vast knowledge on just how dynamic is the capability of change in pathogens isolated from their hosts.

On a broad and philosophical scale, host plants or animals may be considered selective media, simply separating out specific microbes from the myriads in nature by enrichment in vivo. In vitro culture, originally not specific, has by now evolved to a high degree of selective capabilities and has greatly expanded our knowledge of ecology of pathogens and saprophytes alike. It is relevant across the broad spectrum of plant pathology—from studies on biochemical processes in the laboratory to biocontrol in natural ecosystems—that we need greater and greater fundamental knowledge to interpret complex interrelationships occurring in vitro and in vivo. Our quest for and use of pure cultures often clearly establish the etiology of disease and thus facilitate rationale for control even though mixed inoculation is an invariable natural phenomenon. The ecological succession of microorganisms that follows with progression of primary infection and disease initiated by a pure culture is a reality of importance to symptomatology, epidemiology, and control in the field. The discovery that a specific microorganism is the cause, and that it can be isolated and cultured apart from the plant host, distinguishes the science and identifies the discipline of plant pathology.

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