

This Week's Citation Classic®

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Horsfall J G & Barratt R W. An improved grading system for measuring plant diseases. (Abstract.) *Phytopathology* 35:655. 1945.

This paper describes a system for quantifying the severity of a plant disease. It is based on two principles: (a) that the human eye is a photocell that reads in logarithms and (b) that it sees diseased tissue below 50 percent and healthy tissue above 50 percent. [The SC¹® indicates that this paper has been cited in over 165 publications since 1955.]

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When I was a child, I thought that I should become an engineer because I liked to make things and fix things, but when I got to college, I found that engineering involves a lot of math. Even though I got good grades in math, I didn't enjoy it, and so I became a biologist. When I was in school in the 1920s, biology was a descriptive science that by and large eschewed math.

Like an engineer, I wanted to understand the mechanism of action, not just describe it. My mother didn't enjoy this propensity very well when I pulled her alarm clock apart to see what made it tick.

If you are to understand mechanisms, you must be able to measure things. In my field of plant pathology, you could describe the intensity of disease as low, medium, or severe but this was not an accurate measurement. In my research on chemicals to control leaf spot diseases, I needed something more precise.

I wanted to measure disease, not just describe it. My colleague, R.W. Barratt, a graduate student at a nearby institution, was working on the physiology of leaf spot. In working together to try to improve precision, we stumbled onto two principles: (a) that the human eye is a photocell that reads in logarithms according to the Weber-Fechner law of human acuity and (b) that the eye reads the amount of diseased tissue below 50 percent and the amount of healthy tissue above 50 percent. We set up 10 grades of percent of tissue involved; 0 to 3, 3 to 6, 6 to 12, 12 to 25, 25 to 50, 50 to 75, 75 to 88, 88 to 94, 94 to 97, and 97 to 100. A dozen plants in a treatment are read to get an average grade, which can be converted to a percentage with a calibration curve or a computer. An interesting aspect of this paper is that it is an abstract of a talk given at a society meeting. The method was published in a book¹ and also in a review article.²

I am not sure why this 40-year-old paper is a "highly cited item." Since it appeared early in the transition period of plant pathology from a descriptive to a quantitative science, I would like to think that it helped to boost the transition.

1. **Horsfall J G.** *Fungicides and their action.* Waltham, MA: Chronica Botanica, 1945. 239 p. (Cited 55 times since 1955.)

2. **Horsfall J G & Cowling E B.** *Pathometry: the measurement of plant disease.* (Horsfall J G & Cowling E B, eds.) *Plant disease: an advanced treatise. Volume II. How disease develops in populations.* New York: Academic Press, 1978. p. 119-36. (Cited 25 times.)