Chapter 8
Optimizing Leaf Diseases of Apple Scab and Apple Black Rot in the Context of "Useful" Information Measures and Distance Measurements

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ABSTRACT

Detecting disease on crops is an essential and time-consuming operation in agricultural techniques. It takes a significant amount of time and specialized effort. This research provides a clever and effective agricultural disease detection system based on information theory. In the present chapter, first information measures, 'useful' information measures, and distance measures are defined and explained. The authors find out the distance measures between leaves of apple scab (AS) and apple black rot (ABR). Six leaves of AS and ABR are taken into consideration. After measuring the distance, the impact of disease in the leaves of AS and ABR has been noticed. It is shown that this measure can be embedded in most image classification techniques and is subject to reference transformation. Weak and strong information is also obtained. Finally, minimum and maximum distances are evaluated, and our findings indicate that the likelihood of illnesses in plant leaves is low when the information measure of leaves is low.

In the United Kingdom, two major apple fungal infections severely affect apple output. The fungus Podosphaera leucotricha and Venturia inaequalis produce powdery mildew and apple scab, accordingly. Powdery mildew and scab are controlled with up to 19 fungicide treatments per year in the United Kingdom (Burchill, 1975; Berrie & Xu, 2003). Even with such an extensive fungicide regimen, scab

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control failure is common in high-scab-risk years. As a result, it's no surprise that these two illnesses are the focus of East Malling Study's apple pathology research. Apple scab seldom kills its host, although it can lower fruit production and quality substantially. Because of the commercial need for blemish-free fruit, this is especially true recently. In addition to infecting fruit, it can also infect leaves and, less commonly, shoots (leading to wood scab). V. inaequalis is extremely dangerous to immature fruit and foliage. Rainfall in the early spring promotes the discharge of V. inaequalis ascospores from infected leaf litter on the orchard floor. Ascospore discharge is light-sensitive, with the majority of spores being produced during the day (Wrzesien et al. 2018). Ascospores released into the air settle on the surface of vulnerable host tissues, where, depending on temperature and moisture, they can germinate and infect the host. Primary infection occurs when ascospores invade the body in the early spring. Lesions appear after incubation, and the period of incubation is primarily influenced by the ambient temperature. Conidia generated by these lesions are subsequently spread by rain, landing on sensitive tissues (leaves, fruit, and shoots) and causing new infections; this is known as a secondary infection. This process of serious infections occurs all summer long until the tree's leaves fall off at the start of winter. Cultivar susceptibility, tissue maturity, and meteorological conditions all have a role in the incidence and severity of secondary infection (rainfall, temperature, and moisture). In the winter, ascospores are generated on diseased leaves by strains of two opposing mating types.

The Xanthomonas campestris pv. campestris illness, which causes significant damage to all Brassicaceae crops, is a massive issue that scientists and farmers are concerned about (Ryan et al. 2011). According to Bila (2008), Lo & Wang (2001), this disease can cause 30–70% losses in cabbage based on the season According to a study, plant diseases are the main cause of agricultural productivity losses (Priyanka et al. 2022). The analysis of all cultivars' old leaves revealed a substantial difference between one resistant and one vulnerable cultivar is given by (Sina & Rainer 2022). In contrast, there were no discernible changes when young leaves from all cultivars were compared. The disease causes severe damage in Kenya during the wet and warm seasons, culminating in total crop loss (Otipa et al. 2013, Anonymous 2000). Various management strategies have been implemented on farms and in research facilities, but no one strategy has been shown to be effective in controlling the illness (Celetti et al. 2002). Biological control, cultural practices, chemical control, host resistance, and field cleanliness are some of the current techniques used by farmers to treat the condition.

Heated cupric acetate, or zinc sulphate, sodium hypochlorite, and hydrogen peroxide, are used to treat the disease chemically. Miller and his associates (Miller et al., 1996). However, many insecticides used to combat cabbage black rot disease are inefficient, and some others have not been approved (Massomo et al. 2003, Bila et al. 2013). Even though Actigard is designed to reduce black rot on economically farmed crucifers and generates resistance in select plants, the outcomes in cauliflower 535 were unimpressive (Seebold et al. 2008). Moreover, pharmaceutical seed priming just sanitizes the seed surfaces, (Miller 2002) not the germs inside the seed. Traditionally, cabbage crops were sprayed with copper-based fungicides, but it was discovered that they caused black patches on the leaves, thus they were banned (Averre 2000).

Despite their ineffectiveness in the past, the development and adoption of cultivars resistant to black rot have been noted as a key strategy for preventative efforts (Miller et al. 1996). That's also because the majority of indigenous cultivars are relatively delicate (Massomo et al. 2003, Bila et al. 2013). The problem with this approach is that certain varieties are only partially robust or vulnerable to black rot (Seebold et al. 2008), are of bad condition, and hence are not widely adopted by producers. Furthermore, the unusual nature of the source of the significant gene (durable) resistance in Brassica oleracea, novel