

**Distribution, Characterization and *In-vitro* Chemical Screening of *Phytophthora* species
causing Citrus gummosis in Kenya**

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ABSTRACT

A study was undertaken to investigate the occurrence and distribution of citrus gummosis disease in major citrus growing areas of Kenya. To achieve this, a survey was conducted across the country by sampling selected citrus orchards. This study also investigated the pathogens that are associated with citrus gummosis by collecting samples of pathogens from symptomatic tissues of infected citrus plants and rhizosphere soil from affected orchards. *Phytophthora* species were isolated and characterized based upon microscopic examination of morphological characters and growth characteristics on specific media. *In vitro* bioassays of dimethomorph + mancozeb (Acrobat), fosetyl-Al (Alliete), mancozeb (Dithane M45), cymoxanil + propineb (Milraz), metalaxyl + mancozeb (Ridomil) and fosetyl-Al +mancozeb (Verita) fungicides on mycelia growth of each species were evaluated. The fungicides were incorporated in corn meal agar at recommended manufacturers' spray rates of 1.5, 2.0 and 2.5 mg/ml and colony diameters measured for 12 days.

Results from this study showed that citrus gummosis is widespread in all the citrus growing regions of Kenya but majority of the growers do not recognize the disease. The disease was observed in 70 (79 %) of the 90 fields visited with high prevalence being observed in low altitude areas. High gummosis disease incidence and prevalence were observed in low altitude areas characterized by high temperatures and humidity. The highest (33%) incidence was observed in Kilifi district, whose predominant agroecological zone (AEZ) was Coastal Lowland 3 (CL₃). There was a positive and significant ($r = +0.471$, $P < 0.05$) correlation between disease incidence and temperature. Sixty-seven (67 %) percent of growers interviewed did not recognize the disease while 77 % did not know its cause. All citrus varieties grown by farmers were susceptible to gummosis.

Three *Phytophthora* species were isolated and identified based on their morphological, cultural and physiological profiles. Forty five (45) isolates were identified as *Phytophthora citrophthora*, thirteen (13) as *P. nicotianae* and one (1) as *P. syringae*. Virulence tests on lemon fruits performed in the laboratory and stem-inoculation studies on lemon seedlings conducted under greenhouse conditions confirmed pathogenicity of the identified pathogens. All isolates were either sensitive or intermediately sensitive to the test fungicides. Percentage (%) mycelial growth inhibition of all test *Phytophthora* isolates were significantly ($p < 0.05$) different at exposure to different concentrations of the test fungicides.

From these findings, gummosis disease was observed to be widely distributed in the country but majority of farmers do not recognize it. Three *Phytophthora* species namely; *P. citrophthora*, *P. nicotianae* and *P. syringae* were the causal pathogens for the disease. The activity of the test fungicides on growth of *P. syringae*, *P. citrophthora*, and *P. nicotianae* suggests that these compounds could provide control to *Phytophthora* species causing gummosis in Kenya. The study recommends that concerted efforts in educating farmers and extension personnel in diagnosis, spread and management of the disease be put in place. The study also recommends that molecular characterization is performed on these pathogens to establish their true genetic identity. An evaluation of the fungicides used in this study should be done under field conditions to confirm their efficacy.