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A challenging job: plant pathology in the urban environment

May 15 2015, Giacomo Lorenzini, Cristina Nali

According to Agrios (2005), “Plant pathology is a science that studies plant diseases and attempts to improve the chances for survival of plants when they are faced with unfavorable environmental conditions and parasitic microorganisms that cause disease”. So, it is a discipline that has a practical and noble goal of protecting the food (quantity and quality) available for humans and animals. Nowadays to this crucial task at least another mission must be added: “to ensure the presence of well performing and safe plants (especially trees) in our cities”. This is because plant diseases, by their presence, menace the survival of the plants, shorten their life expectancy and make them dangerous in the urban environment representing a limiting factor for citizen’s security.

At world level, far more than 50% of human beings currently live in an urban area and at least 70% will live there in the year 2050. Cities are similar to an organism in that they consume resources from their surroundings and excrete wastes. Urbanization concentrates people, materials and energy into relatively small geographical areas (cities and towns are estimated to be less than a mere 3% of the total land of our planet), whose environmental conditions are often critical. Quality of life in cities relies on a range of components, such as social equity, income and welfare, housing, social relations and education and a healthy environment. The environmental elements for an adequate quality of life include good air quality, low noise levels, clean and sufficient water, fair urban design with sufficient and high-quality public and green spaces, and a good local climate or opportunities to adapt to climate change. Urban trees provide a number of important (but not easily quantified) aesthetic, economic, and psychological benefits (“ecosystem services”) for humans. They increase property values, promote tourism, provide educational opportunities, encourage healthy life styles and outdoor activities, improve the visual appeal of urban areas, mitigate stress and encourage biological diversity. But trees, just as all other plants, may be sick and attacked by biotic and abiotic stress factors, and a diseased tree may represent an intolerable risk factor for human welfare.

Plants in the city guarantee multiple benefits and satisfactions, but they are exposed to a variety of site conditions, environmental factors, and physical disturbances which influence their survival. Climate change has the potential to influence almost all components of the urban environment and to raise new, complex challenges for the quality of urban life, health and urban biodiversity. Due to human activity, the temperature in an urban microclimate is higher than that of the surrounding areas.

City areas are said to be “urban heat islands” as, under calm conditions, temperatures are highest in the built-up city center and decrease towards the suburbs and countryside. Human activity creates urban soils that are distinct from their natural counterparts for physical, chemical and biological features. Anthropogenic materials and contaminants are present. Nutrient cycling is interrupted and soil organism activity modified. Surface crusting is water- and gas-repellent, with restricted aeration and water drainage. Soil structure is modified and heavy compaction is a rule; “sealed” soils are repellent to water and gases leading to compaction.
Environmental chemical pollution is a key stress factor for plants in urban areas. Soil structure (the balance of solids and pores) has been crushed out by mechanical compaction that chokes off water and air exchange. As a consequence, there is less oxygen and more carbon dioxide in the soil. Organic matter is scarce: these substances are periodically deposited on natural soils by trees and shrubs in the form of leaves and branches and organic remains are decomposed by soil-inhabiting organisms, but in urban soils these cycles are interrupted. Leaf litter is often swept up as trash, or very little litter falls on urban soils because of the low amount of biomass produced by the plants. As a result of the shortage of organic matter, the diversity and activity of soil microorganisms (e.g. mycorrhyzal fungi) are reduced well below optimum levels.
Of course, plant pathogens occurring in agro-ecosystems and in forest stands may infect urban plants as well. But phytopathology in the urban environment has a special and peculiar pathogen to deal with: man! In addition to the well-known crucial role in diffusing noxious organisms from one site to another (mainly trading off infected plant material), in the city man has other responsibilities, mainly related to agronomic practises (i.e. pruning with infected instruments). The canker stain pandemics of plane trees (due to Ceratocystis platani) in Tuscany is a huge example: a single chainsaw-borne infection can kill a mature tree in a couple of years.
Woody ornamental species in the city are special plants. Usually they are forest plants (from a botanical point of view) which are treated as fruit plants (from the agronomic point of view), compelled to live in a hostile environment. So, natural defenses against biotic and abiotic stresses are limited in comparison to individuals growing in the natural environment. The objective of pruning urban trees is to produce safe, strong, healthy, attractive plants, but wounds produced by topping and improper pruning may serve as entry points for decay organisms. There are particular cases where individual trees, because of their condition and location, pose an unacceptable risk to people or property. Trees or tree parts can fail particularly during loading events such as wind and snow storms. Trees fail when the load (weight and motion of the crown) exceeds the mechanical strength of their stems, branches or root systems. This is true for both sound and defective trees, but defective individuals can only withstand a fraction of the load that sound trees can withstand. The failure of limbs or entire

trees, however, is often predictable, detectable, and preventable. Tree custodians, who have both civil and criminal (as well as moral) responsibility for the actions and consequences of falling trees, have a duty to monitor the risk factors and minimize the probability of such damage occurring. Tree risk analysis has evolved over time from a qualitative art to a quantitative science. Modern techniques and procedures (most of them based on image diagnostics) can be used to minimize the risks associated with tree failure and to identify structural defects. So, the mission of urban plant pathologists is to verify if a tree has what it takes to stand up in a secure way. This is based on the evaluation of the acceptable safety factor (safe shell limits). Trained and able staff must be available for periodic tree inspections. University courses of Agricultural and Forest Sciences should discuss and investigate these crucial issues..

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