Nigerian Journal of Ecology (2008) 9:20-24.

ISSN: 1116-753X

Managing insect-induced and other biotic stresses of urban ornamental plants

Omoloye A. Adebayo
Department of Crop Protection and Environmental Biology, Faculty of Agriculture and Forestry, University of Ibadan, NIGERIA.

Running head: Urban insect pest management

(Accepted 2 November 2008)

ABSTRACT

Public awareness of the need for a green environment with its overwhelming advantages has been on the increase in Nigeria probably due to encouragement by the government at all levels. Urban tree planting has been encouraged by most state governments through well crafted programmes. However, the insect pest management component of maintenance operations of the planted trees is paramount for sustainability and achievement of the objectives of setting up the programme. Urban tree health care and maintenance programme depend on good understanding of the science and art of design and planning, social and business considerations and public education and awareness. Although there are several ornamental plants that are grown as seasonal, annual or perennial herbs, shrubs and trees, there is a dearth of information on managing the numerous insect pests and mite species that attack the plant or their parts. This report describes the general procedure for diagnosis and management of urban ornamental trees. Environmental sanitation along with intelligent use of pesticides was the major recommendation against most of the insect- and pathogen induced stresses of urban trees.

Key Words: Insect induced stress, Urban, Ornamental, Environmental sanitation, biotic factors

INTRODUCTION

The provision of very good health care and maintenance programme for reducing urban ornamental plant stress depends on a sound understanding of the science and the artistic concepts of design and planning, social considerations, business, and public education and awareness (Dickson and Isebrands, 1991; Mariau, 1999). All programmes in urban plant stress maintenance and health care benefit from correct plant selection which entails putting the right plant species in the right place. It also involves good plant husbandry, taking into cognizance all horticultural considerations (Nash and Graves, 1993; Mariau, 1999).

General plant protection practice is hinged on specific principles and methods that facilitate effective application of procedures and protection practice (Sinclair et al. 1987; Dickson and Isebrands, 1991; Mariau, 1999). For example, a good knowledge of Economic Threshold or Aesthetic Threshold and related concepts has led to increased toleration of some pest populations (Swiecki and Bernhardt, 2006). This has the advantage of saving pest management costs through prevention of uneconomic application of control especially chemical pesticides as well as protection of the environment from indiscriminate pumping of pesticides into it (Nash and Graves, 1993; Yoon, 1995; Mariau, 1999). There is a need to note that some of the terrible consequences of pesticide applications in the environment are development of resistance to pesticides by pest, resurgence of treated pests, contamination of food chain and direct poisoning to people including the person applying the pesticides (Devkota and Schmidt, 2000).

Trees in the urban areas imply deliberate plants within and for cities. It means a direct functional use of plants to improve urban environments for the benefit of people who live there. Managers of urban plants must therefore realize that the perceptions of people matter very much and could sometimes be more important than even scientific facts. For example, it is well known that urban trees add positively to the health of the people (Devkota and Schmidt, 2000). It also provides good aesthetics and mops up gaseous wastes such as carbon dioxide and related gases from the environment. Functional uses of urban trees also means that it screens against unpleasant views and against headlights. It provides additional source of essential food and special nutrition in human diet especially fruits and vegetable production in the cities. It also means reduction of the effects of noise and air pollution as well as the amelioration of climates in urban areas. Thus, urban tree planting is a wise use of plants to improve the human living conditions as in plants and gardens. These are good for the people. The aim of this paper is therefore to identify common insect induced stress challenges of urban trees and their management that would be adaptable to metropolitan cities of southwest Nigeria.

Need for maintenance of plants in cities

Until recently, not so many people appreciate the beneficial relationships between plants and people living in an urban environment. Today, a whole new culture is evolving in Nigeria in response to the growing recognition of plants as crucial to the health of cities dwellers.

Specialists have begun to focus on the special problems, peculiar demands and uses of city plants. Problems such as crowded roots are major challenges in which plant roots cause the need for road repairs. The civil engineer in the city knows more about root growth of these trees than does a research scientist because he has to repair the clogged sewage pipe lines and broken pavement caused by urban trees.

There are also the problems of air pollution, restricted light and water among buildings, intensified wind currents, disturbed soil sites, harsh indoor environments, both in homes and offices. The urban garden comes in all shapes and sizes from public parks to homeowner's gardens, from street trees, with effects upon noise and air pollution and on the amelioration of climates, to office landscapes, and effects on work productivity and employee satisfaction to vegetable gardens which produce essential food and special nutrition in inner city human diets.

Pests of Ornamental Plants

There are several ornamental plants that are grown as seasonal annual or perennial herbs, shrubs, and trees. In the past, ornamentals were considered as important only for aesthetic value. Recently, many of these have achieved significant economic and commercial importance. Numerous insect and mite species attack the rhizomes, root, stem, leaves, shoots, buds, flowers, fruits and seeds of ornamentals and causes immense damage (Ebeling, 1978; Daramola, 1993; Gill, 1993; 1997; Dreistadt, et al., 2004). Despite their importance however, no systematic research efforts have been made to protect ornamental plants. As such, published basic information, such as listing of pests for each ornamental plant species is not readily available.

General consideration for tree health care/ pest management decision

The following considerations should be noted when making tree stress management decisions.

1. Tree species survive and grow best when in their natural ranges. Artificially extending these ranges is risky although, occasionally it's worth the risk; because some species often perform well on foreign continents. In this case, lessons of experience is the only reliable guide. Trees do not always grow best on the sites where they normally occur; but they just compete best in those places. When competition is not a factor however, most tree species tend to grow best on deep, moist, well drained, fertile soils.
2. Mix tree species. When in mixed stands, most trees tend to be less susceptible to attack and less vulnerable to damage from pests. Therefore, if the management objectives do not require pure stands, encourage a mixture of plant species.
3. A full crown is necessary for optimum health and growth. Give the crowns all the light they can use. The crown uses light energy to produce cellulose (a complex carbohydrate) from carbon, hydrogen and oxygen; roots only provide water and nutrients to support the process. A full crown will also ensure that roots have adequate space.
4. A tree's apparent health does not always reflect current conditions. Trees usually respond quite slowly to environmental changes. They may decline over a period of several years before succumbing to prolonged stress; and it may take many years of favorable conditions before they recover fully from a weakened state.
5. Injuries to boles and branches of hardwoods often lead to defect, degrade and decline. Thinnings and other partial cuts should be planned so that injuries are minimized and damaged trees can be removed as cutting progresses. This usually means beginning in the least accessible parts of a tract.
6. Tree decline and mortality following significant soil disturbance. Roots can be damaged by soil compaction, grade change and mechanical injuries. Design access for partial cuts and construction sites so that soil disturbance is minimized around residual trees.
7. Harvest trees when they mature, or expect them to deteriorate bcause teven though trees live longer than people, they don't live forever. Plant vigor decreases or deteriorates as they advanced in age..
8. Well-designed and properly constructed roads help ensure long term plant health. If properly installed the first time, good roads help protect trees against injury, protect water quality and minimize site degradation from management activities.
9. Protect unique areas from disturbance for easy and effective maintainnce and to enhance diversity Unusual habitats tend to include species and environmental conditions that can be difficult to re-establish if lost.

Diagnosing Tree Health Problems

Most tree problems result from combinations of factors (Ebeling, 1978; Daramola, 1993; Gill, 1993; 1997;

Dreistadt, et al., 2004). When the cause of a stress problem is not obvious, there are always clues that can help with diagnosis. However, every condition will not result in a satisfactory explanation. The two major stressors of trees are **abiotic** (non-living) influence, such as drought and this makes trees to be more susceptible to invasion by the **biotic** (living) stress factors such as insects, mites, fungi and other pathogens.

The following guidelines are helpful when diagnosing tree stress problems.

1. oftentimes, abiotic stress caused by physical, chemical and environmental factors usually affect most or all plant species present in an area, whereas (biotic) problems caused by organisms seldom affect more than a few species, and often just one.
2. Stress symptoms caused by organisms usually vary in space and develop over time; whereas the symptoms that appear suddenly which are relatively uniform and which stabilize quickly, are probably not caused by an organism.
3. Occurrence of healthy buds on trees suggest the potential for recovery whereas dead or unhealthy buds suggest that recovery is unlikely.
4. Wilting indicates that water is not moving through the tree fast enough to support normal health. The most common causes of wilting are biotic such as root disease, vascular disease and abiotic in nature such as drought. Vascular disease is usually caused by microorganisms while root disease can stem from physical or chemical injury, excess moisture, infection by microorganisms, and feeding by various animals.
5. Symptoms often result from the effects of secondary agents and not from the primary agents. For example, the trees that have been weakened by adverse weather, unfavorable site conditions, injury, competition or advanced age become more susceptible to infections and infestations by secondary organisms. Therefore, the treatment related to these secondary agents will only provide temporary benefits unless the primary problem is also treated.
6. Most biotic agents that affect only the foliage are unlikely, in themselves, to result in tree mortality but they can reduce growth and predispose trees to other problems. They also create bad sight for ornamental plants. Agents that affect only the heartwood (e.g., some decay fungi) can increase the likelihood of stem breakage, and can make trees unmerchantable, but they might have little effect on tree life span.
7. The symptoms that seem to be associated with aspect, exposure, drainage or disturbance are very likely to involve an important environmental component; but organisms could still be the primary agent(s).
8. Check with a magnifying glass before ruling out the organisms. For example, check for frass, silk, eggs, shed skins or casts, holes, or life stages of insects or mites. If fungus infection is suspected, check for fruiting bodies, lesions, cankers, resin or sap flow, resin soaking of stems or roots, or sapwood stain near the transition between healthy and diseased tissue.
9. Genetic factors can have a noticeable effect on tree response to adverse conditions. Symptoms of ozone injury and needle cast infection, for example, can vary greatly among trees of the same species growing right next to each other.

Tree stress management Procedures

The benefits of preventing or treating tree stress problems depend largely on the perspective and disposition of the manager whether governemnet or individual. Prevention through proper thinning, sanitation and protection is usually most practical.

The following tenets will help establish and maintain healthy trees:

- match species to site. Plant species within its natural range
- favor species mixes where practical
- protect unusual habitats
- give desired trees plenty of light and growing space
- prevent or avoid unnecessary site disturbance and tree injury
- remove undesirable trees
- harvest trees before their quality begins to decline.

Pesticide applications and other special treatments are expensive and should be subjected to cost/benefit analysis. Sometimes, the value of a single, high quality tree is enough to cover the management costs for several acres.

Diagnosis and Treatment of Tree Stress Problems

Where several to many unrelated tree species are affected or only just a few or related species, or only a single tree is affected. Be sure to check out for the following.

Signs of feeding or oviposition. This indicates the presence of generalist feeders such as moths (caterpillars), sapsuckers; oviposition injury by cicadas; small area clearing by woodchucks or mound ants. Defoliation of healthy trees can usually be ignored but protection of unhealthy trees, if desirable, should be accomplished before significant feeding has occurred. Puttting appropriate barriers in place can protect individual trees against birds,

mammals and cicadas. where symptoms are relatively uniform within tree and among trees so that the affected parts (or whole tree) look very much the same wherever they occur or where the symptoms vary within or among trees and may change or progress noticeably over a period of a few to many days (Table 1)

No signs. These could be due to abiotic stress of weather damage; air pollution; chemical injury; site disturbance; fire; flooding (Nash and Graves, 1993; Yoon, 1995). Such conditions are usually beyond practical treatment as trees often recover on their own.

TABLE 1: DIAGNOSIS OF TREE STRESSORS

Tree health condition	***Effects***	***Symptom***
Whole tree is involved	dead, discolored, wilted, missing, debarked	For all the conditions, look out for feeding injury, frass, silk, galleries, holes, shed skins, waxy secretions, honeydew, galls, slits, stage of causal agent (use hand lens; dissect galls, affected twigs, bark): insects, mites, mammals, birds. Other symptoms to look out for often include one or more of the following. cracks, lesions, stains, fruiting bodies, resin flow, cankers, galls, leaf spots or blisters, scorch, bleaching, browning, premature abscission, chlorosis, mottling, epicormic sprouting, necrosis, decay: microorganisms, weather, soil conditions. *Sanitation often helps*.
Only some tissues or parts of tissues not involved:	chemical injury; air pollution; heat or cold injury; lightning, hail or squirrel injury; some insects, mites or microorganisms. *Such conditions are usually beyond practical treatment*.	
Where there are no above ground evidence of biotic agents but ther are some foliage or twig distortion possible	could be due to herbicide, salt or other chemical poisoning; root problems from infection by microorganisms, site disturbance, flooding, girdling by insects or mammals, drought, transplanting shock, shallow soil, winter injury or suppression; vascular disease from microorganisms, including nematodes; storm damage; lightning. *Such conditions are usually beyond practical treatment*.	
Were there are above ground symptoms of infestation, infection or other injury present.	WThese could be due to attck by insects such as bark beetles; severe foliage injury or defoliation by caterpillars, mites, lacebugs, miners, leaf feeding beetles, scales or fungi. *Sanitation often helps; pest suppression is sometimes appropriate*.	

Recommendations and treatment/management options

The potential causes of tree stress problems are countless and complex and an all round one solution or practical treatment options are relatively limited and simple. The following guidelines should help in evaluating what is practical to do in most cases.

1. Know the objective of the planted trees which are usually for beauty, shade, screening, fruit , wildlife habitat, real estate enhancement and some combination of these. Note also that people are concerned most with the appearance and expected life span of their yard trees.
2. Regardless of the cause or nature of tree problems, the only practical treatment alternatives available to most managers are mulching, fertilization, sanitation, watering and pesticide application.
3. Note also that appropriate treatment(s) may be chosen without specific information about the causal agents. Outdoor tree problems resulting from abiotic environmental stress or moderate site disturbance can usually be alleviated by improving soil conditions. Even healthy trees benefit from attention to soil quality. Important soil characteristics include aeration, moisture retention, fertility and drainage.
4. Mulching is the simplest way to improve and maintain soil characteristics. Apply a layer roughly two inches thick over as large an area as suits the landscaping scheme. Mulching also helps reduce injuries from lawnmowers and other equipment. Organic mulch is preferable; avoid piling it against the bole. Where soil compaction is already severe, aerate before mulching.

5. Watering during drought helps, but this is often impractical except for small trees and new transplants because of the large volume required; occasional thorough soaking is best.
6. Nitrogen fertilization is usually beneficial for trees in decline. Avoid changing grade level or drainage characteristics around established trees. Select species adapted to poorly drained soils or install drainage and condition the soil before planting in wet areas.
7. Removal of dead, dying or fallen twigs and foliage is usually harmless and often helpful. When removing infected twigs, cut well back into healthy tissue; sanitize pruning instruments between cuts if transmission of microorganisms is likely.
8. Use of registered pesticides should be considered only after the alternatives, consequences, costs and benefits have been considered and only when unacceptable damage can be prevented through pesticide application

Conclusion

Insect- induced stress of ornamental urban trees as well as other stresses emanating from other biotic fcators such as infection by pathogens can be reduced and managed through effective regular sanitation. The use of other pest sppession methods especially chemical method may be adopted for urban pest management but this should be cautiously balanced with environmental considerations.

References

Bullseye Environmental Services, (2003) Inc. Palm Disease Basics, CEU Category, 772-562-1442. pp. 1-10.

Daramola, A. M. 1993: *Insect Pests of Maize Damage and Control in Nigeria Maize Improvement, Production and Utilization in Nigeria.* M. A. B. Fakorede, C. O. Alofe and S. K. Kim (Eds). Maize Association of Nigeria. pp 171 – 180.

Devkota, R. and Schmidt, G.H., (2000). Accumulation of heavy metals in food plants and grasshoppers from the Taigetos Mountains, Greece. *Agric. Ecosyst. Environ*. **78:** 85-91.

Dickson, R.E. and J.G. Isebrands. 1991. Leaves as regulators of stress response. *In* Response of Plants to Multiple Stresses. Eds. H.A. Mooney, W.E. Winner and E.J. Pell. Academic Press, San Diego, 422 p.

Dreistadt, S.H.; Clark, J.K.; Flint, M.L. 2004. Pests of landscape trees and shrubs. 2nd ed. Agriculture and Natural Resources Publication 3359. Oakland: University of California.

Ebeling, W. 1978. Urban Entomology. Division of Agricultural Sciences Publication 4057. Berkeley: Division of Agriculture Sciences, University of California.

Gill, R.J. 1993. The scale insects of California. Part 2. The minor families (Homoptera: Coccoidea). Technical Series in Agricultural Biosystematics and Plant Pathology, Number 2. Sacramento, CA: California Department of Food and Agriculture.

Gill, R.J. 1997. The scale insects of California. Part 3. The armored scales (Homoptera: Diaspididae). Technical Series in Agricultural Biosystematics and Plant Pathology, Number 3. Sacramento, CA: California Department of Food and Agriculture.

Mariau, D., 1999. Integrated Pest Management of Tropical Perennial Crops (Ed). Science Publishers, Inc. USA. 167pp.

Nash, L.A. and W.R. Graves. 1993. Drought and flood stress effects on plant envelopment and leaf water relations of five taxa of trees native to bottomland habitats. J. Am. Soc. Hort. Sci. 118:845--850.

Sinclair, W.A.; Lyon, H.H.; Johnson, W.T. (1987). Diseases of trees and shrubs. Ithaca, NY: Cornell University Press.

Swiecki, Tedmund J. and Bernhardt, Elizabeth A. 2006. A Field Guide to Insects and Diseases of California Oaks. United States Department of Agriculture Forest Service, Pacific Southwest Research Station General Technical Report PSW-GTR-197 158pp

Yoon, T. M. 1995. Effects of water stress on water relation parameters and stomatal conductance of ‘‘Fuji’’ apple trees. Gartenbauwissenschaft 60:16--21.