CROP ROTATION, SANITATION AND RESISTANCE FOR URBAN PEST CONTROL[1]

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Abstract. A review of all types of pest control techniques useful to the urban arborist is presented. Recent developments in chemical and biological controls are discussed. Modifications of traditional cultural control techniques for urban use are presented.

Urban pest control is years behind the agricultural fields. Many integrated pest management (IPM) programs have been developed for field crops, fruits, and vegetables. These IPM programs use the entire spectrum of pest control techniques in such a manner as to reduce cost and minimize adverse effects on the environment. This paper will review these techniques as they relate to ornamental trees and shrubs placed under the care of the urban arborist.

Pest control techniques can be broken down into three broad categories: chemical control, biological control and cultural control (National Acad. Sci. 1969).

Chemical control. Most of us are familiar with the usual chemical control material — pesticides. However, there are other chemicals which have been used to control pests and which should be useful to the arborist. These other chemicals include attractants and repellents (often called pheromones) (Birch, 1974). The attractant pheromones, usually sex or aggregation pheromones, have been identified for a variety of insects such as the clear wing moth borers (ash borer, lilac borer, peach borer) (Neal, 1979), bark beetles (Pearce, et al., 1975), and the Japanese beetle (Ladd, et al., 1975). These pheromones, by themselves, have not been overly successful for control of the pests but have been extremely useful for monitoring pest activity. Pheromones used for monitoring pest activity can be put on sticky traps and conveniently placed in areas to be observed. By checking one of these traps "baited" for a specific pest, the arborist can accurately time another control treatment, such as a borer spray, to obtain maximum control. In this case, we "integrate" two chemicals in order to maximize the usefulness of one, the pesticide, and reduce adverse environmental effects — elimination of several untimed sprays.

Biological control. Biological control is the use of parasites, predators and pathogens to reduce pest populations. The parasites are usually small wasps or flies whose larvae eat up their pestiferous host from the inside. Please note that these wasps are not the stinging bees and hornets and the flies are not the same ones found around the garbage dump! Predators usually include the lady beetles, lacewings and syrphid flies. A major problem with these predators is that few people recognize these predators in their most efficient stage — the larva. As an illustration, in the summer of 1978, the Norway maple aphid was a serious problem in Pennsylvania. One July morning, an alarmed homeowner called and stated that his Norway maple was being "killed by these big ugly bugs" and they turned out to be the larvae of a large lady beetle. Within a week, the Norway maple aphids and the lady beetle larvae were gone. Pathogens of pests are lethal diseases. The diseases which appear to be most useful are viruses and bacteria. In fact, two bacteria, *Bacillus thuringiensis* (Harper, 1974) and *Bacillus popillae*, (Dunbar, 1975) are on the market, as well as a NPV virus — Gypchek (Yendol, et al., 1977). *B. thuringiensis* and Gypchek are lethal to many caterpillars and *B. popillae* is the pathogen of Japanese beetle grubs. Again the major problem with these products for the urban arborist is that most people associate viruses and bacteria with colds, flu and stomach ache. The pathogens of pests only attack the pests and not people. Fortunately the companies that market these pathogens package their products so that they look like and sound like pesticides (Doom, Dipel, Thuricide).

Biological control for the arborist is still in its infancy but will soon reach adolescence. Our West Coast friends are much farther ahead of the East,

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at least in their thinking. Olkowski, Kaplan, and van den Bosch (1978) suggest four strategies to be used to implement biological controls in the urban environment: conservation, augmentation, periodic colonization and importation.

Conservation involves better timing of pesticide usage to avoid hitting predators or parasites, using selective pesticides such as Primor which kills aphids, or using host trees which are not sprayed to maintain predators and parasites. Augmentation procedures attempt to increase existing natural enemies of pests. An example of this is the food spray, Wheast, which is used to feed lacewing adults. Planting of flowers as pollen and nectar sources may also provide necessary food for parasitic fly and wasp adults. This would include the spraying of bacteria or virus as well as releases of parasites and predators. Importation is bringing exotic parasites and predators into the country for release against pests. This tactic is especially useful when combatting imported pests.

Cultural control. We finally come to the cited topic of this paper, cultural controls of insect pests of urban ornamentals. A useful definition of cultural control is the manipulation of the physical environment so as to reduce the survivorship of a pest. In essence, any changing of the environment or habitat which makes it difficult for a pest to survive and reproduce falls in this category.

Crop rotation, sanitation and resistance were picked because these are claimed, almost exclusively, for use in field crops and vegetables. However, these controls are used and could be more useful if modified for urban arborists. It would be prudent to state that the following suggestions have not been generally investigated in a scientific manner and the recommendations often do not fit within the norm for arborist training.

Crop Rotation. Crop rotation is the switching from one species of crop to another. This time honored agronomic practice has generally been ignored by growers of ornamental plants. However, if we consider that trees are merely a crop which is planted, matured, harvested and replanted, the only difference is in the time of maturation. Also, if the trees had continuing pest problems in the past, why replant with the same type of trees? Why not go with a new species?

Christmas tree growers in Pennsylvania are having a similar problem. New growers who planted their acreage with Scots pine usually didn't have severe pest problems until a few years before harvest. However, after harvest, if the land was replanted in Scots pine the pest problems were immediate and continuing. Some growers have recently experimented with crop rotation and have had good success. On land that will only support pine, these growers have planted a cover crop of grass or buckwheat for a year before replanting with trees. Other growers have land which will support spruce or fir and have successfully rotated to these species.

Another anticipated problem with urban tree crop rotation is the American ideal of "biggest and oldest tree." Let's face facts, the urban environment is not the place to grow the biggest and oldest trees. The general requisites of good soil, water and space are usually not present in urban environments in sufficient quantity to support mature trees. It seems foolish indeed to keep spending money to maintain an old tree when its roots have recently been covered by asphalt and concrete. In fact, there seems to be good evidence that such stressed trees produce attractants for pests and are unable to ward off pest attack. A more logical approach would be for the urban arborists to establish a resource rating system for places where trees are to be planted. Trees with matched resource demands could then be planted in each area, then an immature tree must be rotated off the spot and replaced when its size exceeds the resources.

Sanitation. In field crops, sanitation means cleaning off remaining plant residue after harvest and disposal or removal of unwanted plants — weeds. This concept can be modified to fit the urban situation. Cleaning off and removal can be likened to pruning of diseased and insect-infected tree parts. Accumulations of leaves, weeds and other organic material around bases of trees serve as overwintering sites for beetles, sawflies, and other insect pests. Cleaning of the area under a tree exposes the delicate resting stages of pests to harsh weather and stress. Some common pests which can be controlled this way are the oak twig pruner, the European sawfly, birch leafminer and holly leafminer.

Another form of sanitation involves removal of one pest in order to reduce another. Aphids on a maple tree can produce copious honeydew which serves as food for flies, carpenter ants, and sooty fungus. The sooty fungus, ants and flies affect man's environment. Thus, by removing the aphids, by chemicals or parasites, the other pests are reduced (Olkowski, et al., 1076). Such relationships illustrate the complex ecological web that may exist around a single tree.

Resistance. Of all the cultural control techniques available, host plant resistance to insect and mite pests appears to be the most promising (Morgan, et al., 1978). Resistance can take the form of a tree not being suitable for pest survival or the ability of a tree to tolerate a pest without severe reduction in the tree's growth. In another presentation of this convention, Gerhold has presented information on tree resistance and suitability of tree types for urban habitats.

It would be prudent to point out that there are many levels of resistance, and the resistance often varies according to management practices. In short, a tree grown in an ideal nursery or research plot may exhibit very different resistance in the urban habitat. Thus, when arborists select tree varieties that are said to be resisant to insect pests, one should ask whether the resistance was demonstrated in the urban habitat.

A problem with resistance in the form of tolerance is the possible build up of pest populations which influence other factors. If a linden is found which can tolerate an infestation of cottony scales, copious amounts of honeydew are still produced. This honeydew falls on pedestrians, sidewalks and cars and feeds flies, wasps and ants. Thus, this tolerance is less desirable than a non-tolerant plant.

Summary

The "good ole days" of spraying a single insecticide to exterminate tree pests are long gone and urban arborists must think in terms of pest management. This management, at times, will be very complex and may require cooperative efforts of scientists, consultants, and arborists. However, the urban arborist should try to learn the terminology of integrated pest management i.e., selective insecticides, pheromones, cultural control, and biological control.

In the end, an IPM program does not need to be too complex or more costly. In a pilot program carried out in California (Olkowski, et al., 1978), insecticide usage was reduced 93% on over 450,000 trees without significant reduction in quality. Actual pest control costs were also reduced because fewer sprays were applied. Therefore, the major obstacle standing in the way of using modern pest management by arborists is not costs but attitudes toward new or difficult techniques.

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