AN INTEGRATED INSECT CONTROL PROGRAM FOR STREET TREES

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Over the last three years the Recreation and Parks Department of the City of Berkeley has worked with members of the Department of Entomological Sciences, University of California, Berkeley, to develop an integrated insect control program for the city's 30,000 street trees. The program has virtually eliminated synthetic chemical insecticides as regular management tools on the city's 123 species of shade trees. This program has resulted in lower pest management costs, fewer citizen complaints, elimination of secondary pest outbreaks and a reduction in environmental contamination. By reducing the amount of pesticides used, the city of Berkeley saves about $22,500 each year in labor and pesticide costs. The current program is a synthesis of various non-toxic management methods including biological, microbial, cultural, physical—along with the judicious use of chemical controls, when needed.

MOST STREET TREES are not native to the region in which they are planted and are therefore subject to occasional invasions by insects that belong to exotic ecosystems. Often a plant-feeding insect invades an area that lacks the beneficial insects which would serve as natural controls on the invading species. The frequent result is an abnormally high population which natural enemies in the invaded system cannot control. Such insect problems may be permanently solved by classical biological control, which involves determining the native area of the pest, a searching in that area for its natural enemies (parasites and predators), identifying the carnivores, selecting candidates for importation, collecting and shipping them, subjecting them to quarantine processing (where all but the desired new species are destroyed) and finally, colonizing the imported natural enemies on specific host insects. This procedure was successfully followed for three species of aphids (*Eucallipterus tiliae*, *Tinocallis platani*, *Tuberculoides annulatus*), which attacked linden, elm and English oak trees, respectively. They were brought under control by the following five species of parasitic wasps: (1) *Trioxys curvicaudus* Aphidiidae and (2) *Mesidiopsis subflavescens* Aphelinidae, both from France and Italy; (3) *Mesidiopsis subflavescens* Aphelinidae, from Czechoslovakia; (4) *Trioxys pallidus* Aphididae, from Holland; and (5) *M. subflavescens* Aphelinidae from Italy. These wasps reduced the aphid population to the point where insecticides have become unnecessary. Since these host-specific parasitic wasps have overwintered and propagated themselves, no other control efforts are anticipated.

Many species of caterpillar, including California oakworm (*Phryganidia californica*), may be safely and selectively controlled by *Bacillus thuringiensis* sprays. This spray is available in several commercial formulations, some of which were used for oakworm control in 1969 by the California Division of Highways and by the City of Berkeley in 1970. Because *B. thuringiensis* kills only caterpillars, no harm is caused to the beneficial insects, birds and animals that provide biological control of other potential pests.

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UC SALTON: A New Cultivar of Alfalfa for Low Desert Valley Areas of Southern California. Bulletin 864. This publication describes a new alfalfa cultivar which resists the low desert valley summer disease complex. It is also resistant to the spotted alfalfa aphid biotype Ent F and to the pea aphid, but is expected to be susceptible to most leaf and stem diseases.

POWDERY MILDEW DISEASE OF GRAPEVINES. Leaflet 212. This publication describes the effects of powdery mildew on grapes. It describes the life cycle of the fungus, conditions favorable to its spread, and methods of control and eradication in both table grape and wine or raisin grape vineyards.

Water sprays

High pressure water spraying was substituted for insecticides on elm, English oak, birch, pyracantha, plum, scarlet oak, beech, ash and big leaf maple. With trees greater than 30 ft in height, line pressures were increased to 600 psi to permit coverage of the highest parts of the infested portions of trees. Some large trees were only partially sprayed to remove localized infestations. Disadvantages of this technique include the possibility of severe leaf removal by the spray on lower portions of trees, fraying of foliage and excessive mortality to beneficial insects. However, through proper seasonal timing and adjustment of line pressures, water spraying is an extremely useful, inexpensive and harmless pest control technique.

Adhesive bands

The Argentine ant (*Iridomyrmex humilis*) occurs on most street trees in Berkeley and is associated with all of the pest aphid species. In many cases *I. humilis* increases population levels of honeydew producers, especially aphids, by interfering with beneficial insect populations. When aphid and ant populations are excessive, sticky adhesive bands of "Stickem" (1 inch wide, and 1/8 inch thick about 5 ft above ground) around tree trunks exclude ants and reduce aphid populations. This barrier is effective during spring, summer and fall, and although unsightly to some people, captures many insects, particularly flies. It also stops the passage of predators that have fallen from trees, but provides a nontoxic aphid control and ant management tool useful in urban areas.

Since many of Berkeley's pest aphids prefer the inner portions of host trees where the vegetation is usually more succulent and the temperatures are cooler, their populations can be reduced by selective pruning. Pruning for the reduction of preferred aphid food sources was used successfully on linden, elm, English oak and ash.

In 1972 reduced amounts of the insecticides diazinon and dimethoate were used because of better monitoring with fewer unnecessary treatments. In 1973 it was necessary to spot treat (with diazinon) six sweet gums (*Liquidambar styraciflua*) for heavy infestations of the calico scale (*Lecanium cerasorum*). Benlate, a systemic fungicide was used against ash anthracnose in 1972 and 1973. In 1972 about 400 (out of a total of 600) trees were sprayed while in 1973 about 100 were treated. In the future this number will probably be reduced still further by spot treatment of susceptible trees only.

Another important aspect of the program was the care to respond to citizens who called the Recreation and Parks Department about pest problems. Staff members contacted them directly and through written information sheets to explain the department's pest management decisions. These steps frequently helped such persons adapt during difficult periods when honeydew drip was excessive.

Inspection at the complaint site usually reveals one of three situations: (1) plant damage, (2) honeydew contamination, or (3) annoying insect populations. In the Berkeley study, priority lists for repeated monitoring were developed with plant-damaging insects first, then honeydew producers, and finally the annoyance problems. Depending on severity of the complaint, number of plants involved, and the investigator's judgment, particular problems were monitored and additional studies were undertaken. These studies helped to sort out the potential biological control candidates from those that could be managed otherwise.

In the three years Berkeley has had this program, pesticide costs have dropped, regular calendar spraying of large numbers of trees has been eliminated, complaints from citizens have been reduced, and an efficient organized approach to solving a complex management problem has evolved.

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Influence o

THE DEPTH at which asparagus crowns are placed in the soil or are direct-seeded varies in California between production areas and between growers in a single area. The influence of different seeding depths on asparagus production has not been clear. Some studies show that ridging increases yields. These studies do not specify the depth of soil cover over the plants, however.

This report summarizes the progress of both field and lathhouse studies initiated in 1969 to determine the effects of planting depth on the production of green asparagus. Results were judged in terms of earliness of production, yield as measured by number and weight of spears, and spear size.

Asparagus Var. 72 was direct-seeded into the bottoms of pre-formed furrows 2, 6, and 12 inches in depth. The plantings were made in double rows per bed at a seeding rate of 40,000 seeds per acre in May of 1969. The two rows were spaced 12 inches apart in the bottom of the furrows. Each treatment plot was 165 ft long, with rows on 5 ft centers, and was replicated four times in a randomized field plot design. The plants were grown the first season in open furrows with no additional soil cover. The second season the planted furrows in the two deeper treatments (6 and 12 inches deep) were filled with soil to the same height as the level of the beds in the 2 inch deep planting. This placed the crowns at a depth of 12, 6, and 2 inches below the soil surface.

The only change in cultural practices utilized in this test that differed from those used in commercial fields was the elimination of the rototilling operation in the spring during the preparation and shaping of the beds prior to harvest. This was necessary in order to avoid the possi-