IPM Monitoring Systems for Nursery Production

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Integrated Pest Management (IPM) is an approach to pest control developed during the past 30 years. It can be defined as use of all available techniques to maintain pest populations below economic injury levels (Pfadt, 1978) Pest control has shifted toward IPM because pesticides failed to provide permanent suppression of pests and because of concerns for the environmental and safety risks of pesticides. Adoption of IPM has been credited with reducing insecticide use in agriculture during the 1980s (Zilberman et al., 1991). IPM can provide these benefits to nurseries without sacrificing productivity or quality, if it is applied properly.

The three elements of an IPM program are. economic thresholds, control methods, and monitoring techniques. Monitoring binds thresholds and controls together into a workable IPM program It measures pest populations against the economic threshold to ensure that controls are timed correctly and are used only when necessary. Intensive monitoring systems were the key element of IPM programs developed for apples (Prokopy et al., 1980). They are essential for nursery IPM as well.

We have developed and operated an IPM monitoring system for tree nurseries during the past twelve years. It illustrates monitoring techniques used in nurseries and the benefits of IPM. It also illustrates two principles essential to development of an effective IPM program. First, sampling data must be accurately recorded and maintained. Second, the biology of insect pests must be understood.

In our monitoring system a weekly report is prepared for each field. It details the location and cultivars where samples were collected; and also records the species of insects found, the numbers present, and the amount of injury. Our monitoring program focuses on two primary pests. The leafrollers that destroy terminal buds in spring as well as spider mites that defoliate trees in late summer. We sample 400 to 1200 trees per field and examine the terminals closely for leafroller larva We also collect 80 to 240 leaves per field and count spider mites with the aid of a hand lens.

Initially, monitoring reports provided data that nurseries required to apply pesticides based on their own thresholds. They still serve this basic function of making treatment decisions based on an economic threshold The reports also form a data base that has increased our understanding of insect biology. This information helps us refine economic thresholds, pest control practices, and the monitoring system itself.

The first biological information that we obtained from monitoring data was the identity of the principal leafrollers attacking nursery stock. These were winter moth, *Operophthera* ssp, eyespotted bud moth, *Spilonota ocellana,* omnivorous leaf-tier, *Cnephasia longana;* and obliquebanded leafroller, *Choristoneura rosaceana*. Larva of all four species feed on leaves and buds during the spring. The oblique-banded leafroller is the only species that has a second generation during the summer We supplement field sampling with pheromone traps to predict emergence of second generation obliquebanded leafroller, but in the spring we must rely on intensive field sampling for all leafroller species. Monitoring showed that the omnivorous leaf-tier was the most damaging species. Other leafrollers feed on any leaf they encounter, but omnivorous leaf-tier concentrate their feeding on meristem tissue in the apical buds. A single larva may move along the tree row and destroy several buds in succession. Infestations of this species develop quickly because larva spin silk threads and are blown in from overwintering sites outside the nursery. Our records of leafroller feeding injury showed us that field monitoring may not detect infestations of omnivorous leaf-tier before economic damage occurs. Therefore, we used the sampling data to develop a degree-day model to predict emergence of this species. Pesticide applications can be timed more accurately by combining monitoring and the degree-day model This minimizes damage by omnivorous leaf-tier without resorting to a costly calendar spray schedule.

Monitoring data for spider mites also identified our principal mite pest, the two-spotted spider mite *Tetranychus urticae*. This species overwinters in the soil and does not colonize nursery stock until late spring or summer We rarely find European red mite *Panonychus ulmi*, which overwinters as an egg on the plants. This information allowed apple nurseries to eliminate the dormant oil spray commonly applied in apple orchards to kill eggs of the European red mite.

Our records also documented the host preferences of the two-spotted spider mite. In shade tree nurseries, honeylocust, *Gleditsia triacanthos*, and European mountain ash, *Sorbus aucuparia*, have damaging populations nearly every year. Green ash, *Fraxinus pennsylvanica*, and Norway maple, *Acer platanoides*, are rarely affected. Spider mites even have preferences among cultivars of the same species. The apple *Malus pumila* [syn. *M domestica*] rootstock cultivar 'EMLA 7', is usually much more heavily infested than 'EMLA 26' Host preference information for spider mites permits us to concentrate sampling in susceptible cultivars This reduces the cost of monitoring It has also enabled nurseries to reduce the cost of spider mite control by limiting miticide applications to susceptible cultivars

Our monitoring records of pest injury and chemical use document the benefits of a nursery IPM program. Figure 1 shows spring bud loss due to omnivorous leaf-tier and other leafrollers.

During 12 years of IPM monitoring, damage caused by leafrollers has declined by approximately 90%. During this period pesticide use was reduced by 50% (Figure 2) Pest control at this nursery was improved by timing pesticide applications more accurately, eliminating unnecessary treatments, selecting more effective pesticides, and improving application equipment. The monitoring system was directly responsible for the first two changes. It contributed to the others by evaluating chemicals and by demonstrating the need for improved equipment.

Table 1 shows the record of spider mite infestations and miticide use in an apple rootstock production bed during nine years of IPM monitoring. Infestations by spider mites have fluctuated widely due to climatic variation. Monitoring has not had a noticeable impact on spider mite populations Miticide use was reduced, however, by shifting from full cover sprays of the entire field to spot treatment of infested cultivars IPM monitoring has been an important factor responsible for this reduction in pest control costs

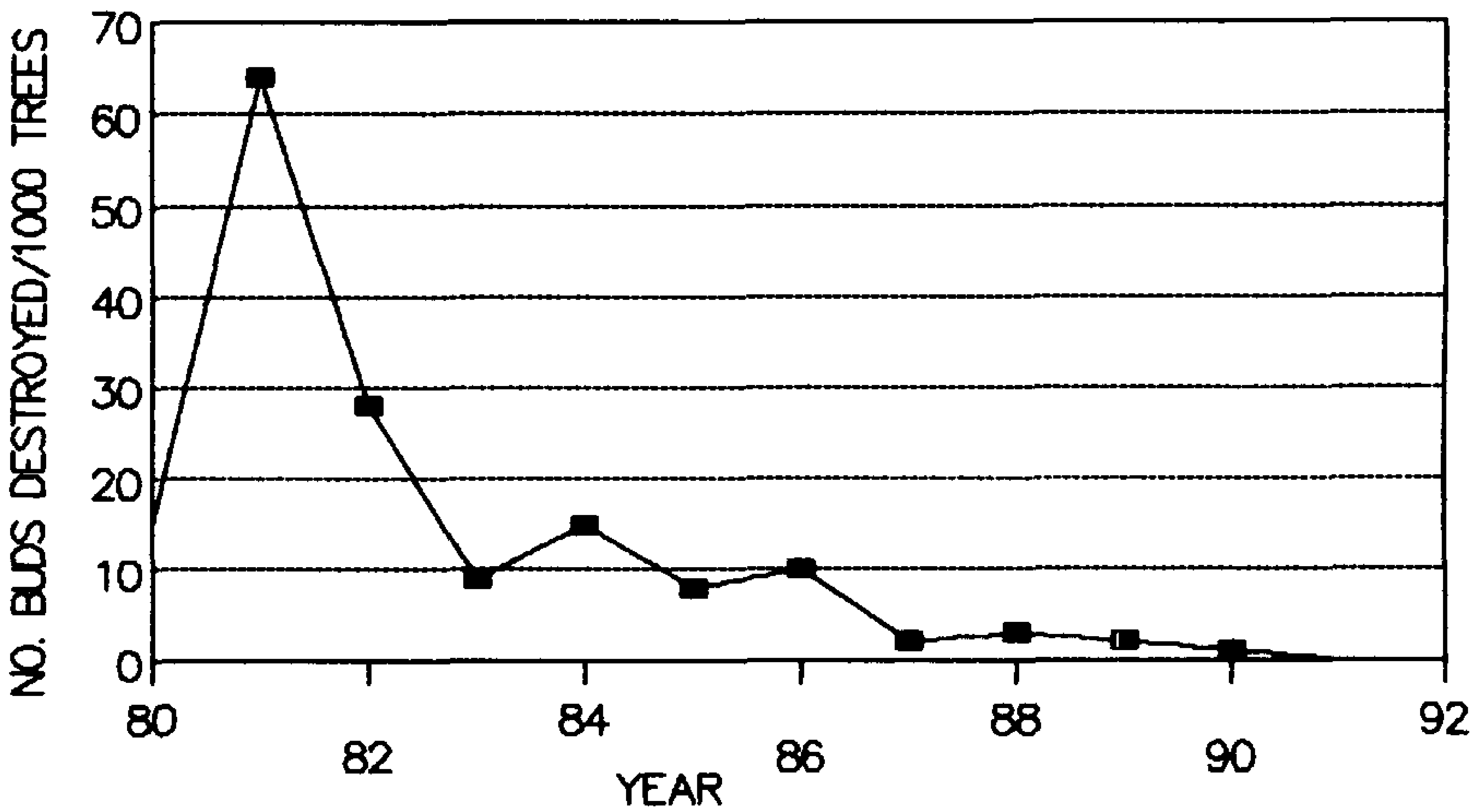

Figure 1: Leafroller damage in 1-yr budded trees. Nursery Treco, Inc

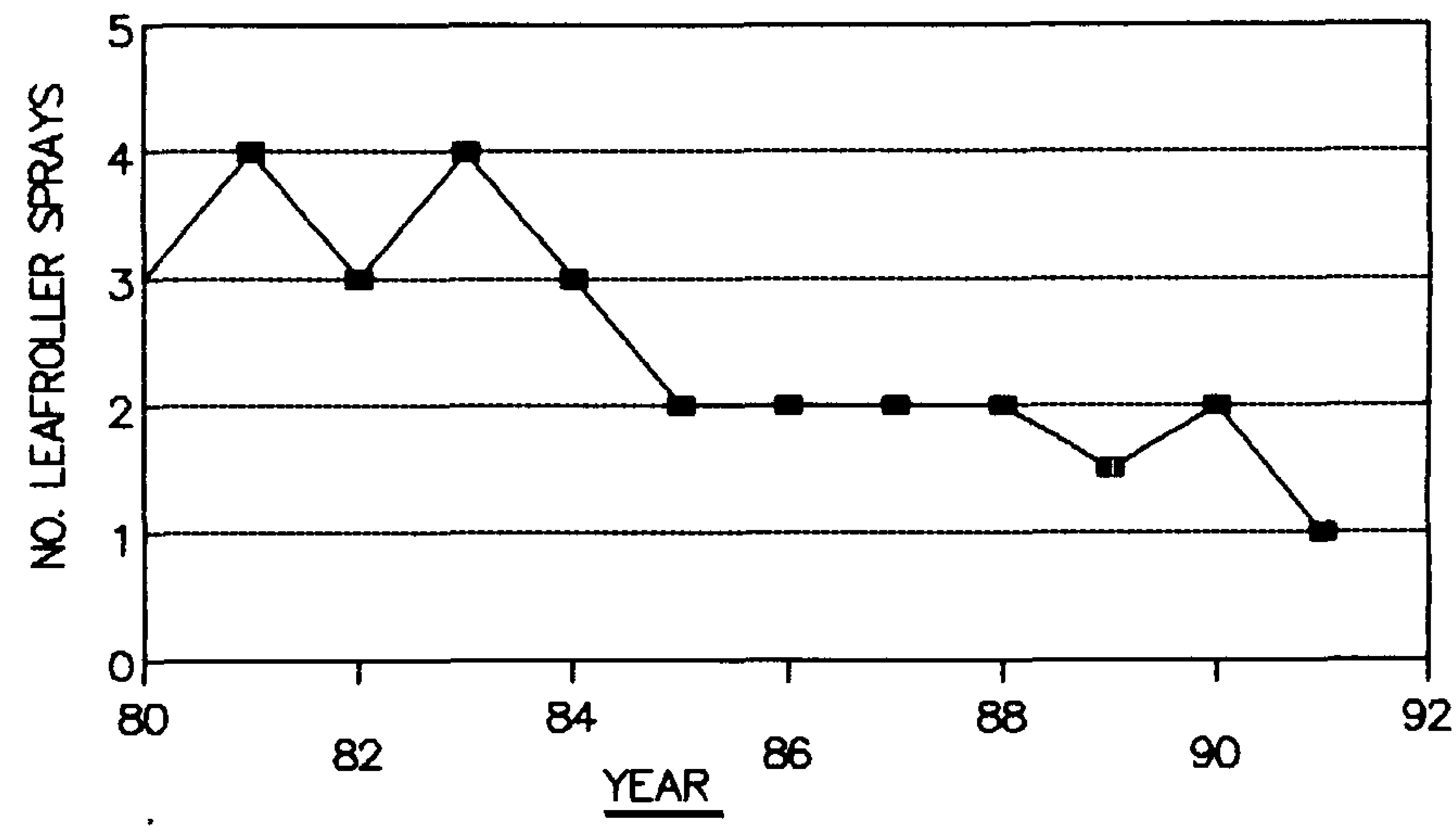

Figure 2: Pesticide applications for leafrollers. Nursery Treco, Inc

This nursery IPM program reduced use of pesticides to control leafrollers and mites and it also reduced injury by leafrollers. Other nurseries that use IPM monitoring have reported similar benefits:

1) Fewer pesticide application, lower costs for chemicals and labor.
2) Reduced labor costs to repair damaged plants.
3) Increased percentage of undamaged, saleable trees.

Integrated Pest Management is an effective tool for nursery production. It requires rational economic thresholds, effective pest controls, and good monitoring techniques. The monitoring component of a nursery IPM program must be based on thorough sampling, accurate recordkeeping, and a detailed knowledge of insect biology.

Table 1. Spider mite infestations and miticide applications in apple rootstock. Nursery: Treco, Inc

Year	Maximum density of mites (no /leaf)	No of full treatments	No. of spot treatments
1982	7 3	3	1
1983	10 3	2	3
1984	8 6	2	1
1985	10 0	2	3
1986	1.2	2	2
1987	22 3	1	2
1988	2 8	1	2
1989	5 1	0	3
1990	14 3	1	1

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