Integrated Pest Management in Forest Nurseries of the USDA Forest Service

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There are twelve USDA Forest Service nurseries in the United States; all grow tree seedlings for reforestation or revegetation/rehabilitation projects. Many have been in existence since the early 1900s, the Wind River Nursery on the Gifford Pinchot National Forest in Washington State was set up in 1909 to grow seedlings to reforest the Yacolt burn, a huge area in southwest Washington destroyed by forest fire. The youngest nursery is the J. Herbert Stone Nursery in southwest Oregon, which produced its first seedling in 1978

PEST CONTROL AND PESTICIDES

Over the years, many pest control tactics, ranging from manual weeding by crews of housewives living near the nursery to mechanized fumigation of nursery fields, have been used in Forest Service nurseries. Each method had a reason for being used. Often one method was used because it was the only method that was available or effective. In the 1950s and 60s, a multitude of new pesticides were introduced to the agricultural community and their killing power and low cost allowed the nurseries to produce large quantities of cheap seedlings.

The world has changed. Pesticides are being detected in water sources, including groundwater. Nurseries have begun to be surrounded by houses as the population of the United States grows. Activist groups have been formed whose primary objective is to reduce or eliminate pesticide use. Pesticide residues on food are a growing concern. Ironically, while the use of pesticides on crops in the United States has increased 33-fold since 1945, the percentage of crops lost to pests has not shown a concurrent decrease; losses have actually increased (Pimentel, et al , 1991).

NATIONAL ENVIRONMENTAL POLICY ACT AND ENVIRONMENTAL IMPACT STATEMENTS

In response to these concerns, Forest Service nurseries are beginning to develop ways to reduce their use of pesticides. The first step has been to prepare an environmental impact statement (EIS) on nursery pest management for each nursery. An EIS is a document required by the National Environmental Policy Act (NEPA) of 1969 whenever an action by a federal agency might have a significant impact on the environment and the people within that environment A nursery's pest EIS outlines a workable integrated pest management (IPM) program for each nursery.

INTEGRATED PEST MANAGEMENT

IPM in the Forest Service is not new; in fact, it has been Forest Service policy to practice IPM in all their pest management activities since 1982. IPM is not new to forest nurseries either; many nurseries have been using an IPM program, or parts of one, for many years. It is only now, however, that a formal legal

commitment to IPM in Forest Service nurseries has been made. The definition of IPM that is being used for the Forest Service nurseries stresses the consideration of values other than economics in selecting treatment timing and method

> "Integrated nursery pest management is the maintenance of seedling pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with nursery management goals. It is implicit that the actions taken are the end-result of a decision-making process where pest populations and their impact on hosts are considered and control methods are analyzed for their effectiveness as well as their impacts on economics, human health, and the environment." (USDA Forest Service, 1989)

IPM IS A DECISION-MAKING PROCESS

At the heart of this IPM definition is the decision-making process: **how** the nursery should go about deciding if a pest is a problem, when to treat, and what method to use. The decision-making process is diagrammed in (Figure 1):

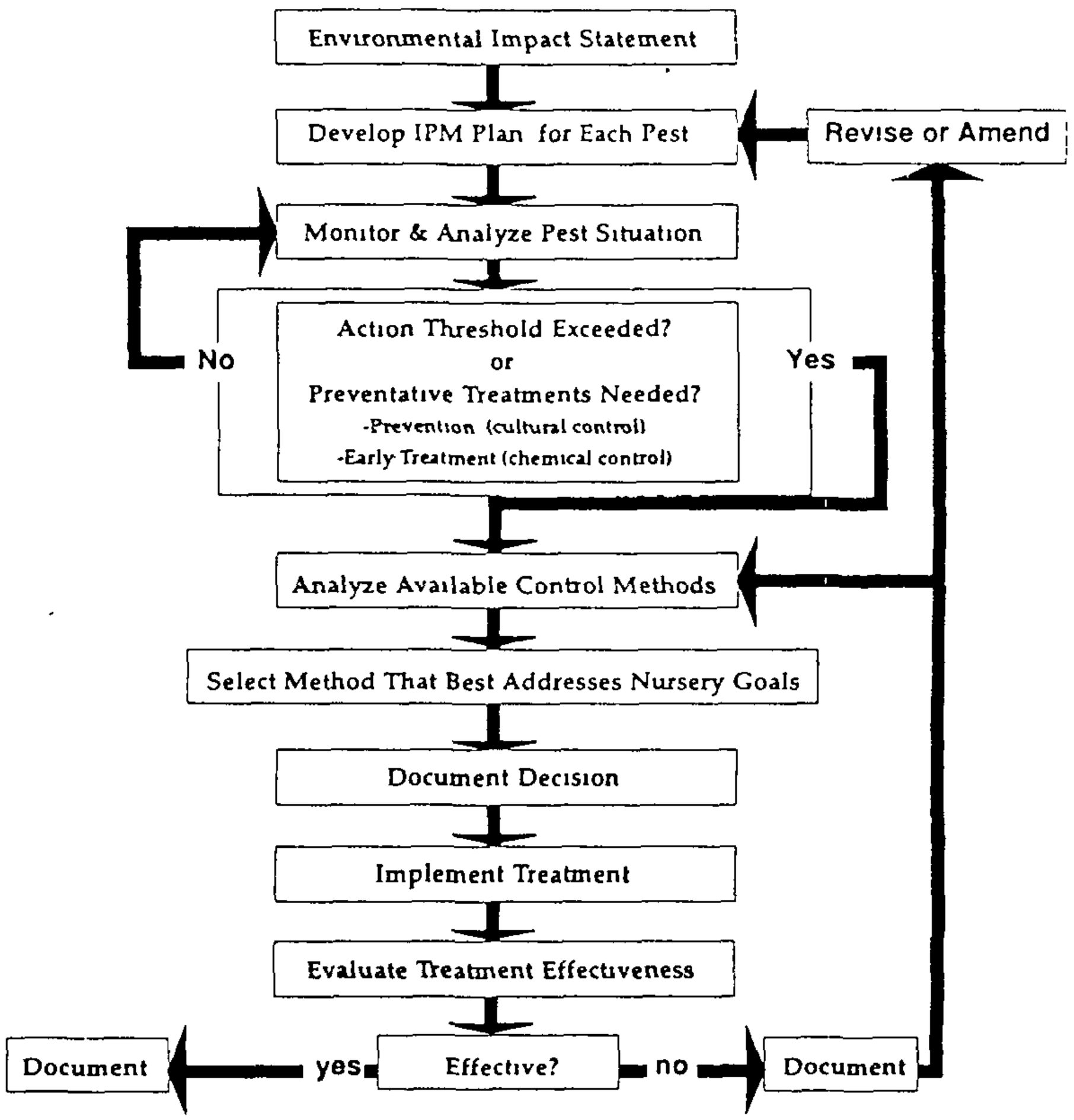

Figure 1. The decision-making process used by USDA Forest Service nurseries for their IPM programs

Most of the steps are self-explanatory. However, explanations of the "IPM Plans" step and the "Monitor Pest Population or Damage" step may be helpful.

IPM Plans. An IPM plan is necessary for each pest that occurs at the nursery. At a minimum, the plan should include

1) ***Information on pest biology and impact, including damage thresholds if known.***

2) ***Monitoring procedure.*** A brief description of how the pest or its damage will be tracked and assessed is included in the procedure. Items such as frequency of monitoring, where to look for the pest or its damage, damage or pest assessment methodology, species, and age of target crops, and monitoring data sheets are useful.

3)***List of treatment alternatives.*** All biological, cultural, and chemical treatment methods (or combinations thereof) (including no action) should be included if effective and feasible

4) ***Pesticide information.*** Product labels, material safety data sheets (MSDSs), health effects, environmental impacts should be included or their location at the nursery referenced.

5) ***Comparison of treatment alternatives.*** Treatment alternatives should always be compared to one another with regard to effectiveness, impact on environment, impact on human health, and cost. A simple comparison matrix for control of cranberry girdler moth (*Chrysoteuchia topiaria*) is shown here (Table 1).

Table 1. A comparison of control alternatives for the cranberry girdler moth at the J Herbert Stone Nursery

Treatment option	Human health risk	Risk to environment	How effective	Cost to treat	Preference rank
1. No action	None	None	None	None	Low
2. Weeding and mowing	Negligible	Negligible	Low to moderate	High	High
3. Use of Bug Vacuum	Negligible	Negligible	Moderate	Moderate to high	Moderate to high
4. Spraying of Pydrin	Moderate	High	Moderate to high	Moderate	Moderate to high
5. Combination of B and D	Moderate	High	High	Moderate to high	High

6) ***Annual decision and decision rationale.*** The selected treatment or combination of treatments is documented and the reasons for selecting it are described. This decision should be reviewed each year and modified if necessary.

Monitor Pest Population or Damage. For some pests, it makes sense to monitor their population or the damage they cause and begin control measures

when a threshold level is reached Threshold levels may be quite sophisticated, such as a certain number of insects per trap, or quite simple, such as the presence or absence of the pest on the seedlings. Monitoring works well in forest nurseries for insects, foliage pathogens, and weeds.

For other pests, such as soil-borne fungal pathogens, preventive activities or treatments must be made long before the seed is even sown in the soil in order to prevent significant losses. In these cases, monitoring is not as useful and the decision to treat or not must be based on historical occurrence of the pest or climatic, soil, or seedling conditions that may pre-dispose the seedlings to attack or infection.

HIGHLIGHTS FROM ONE NURSERY'S IPM EFFORT

In 1990, the J. Herbert Stone Nursery, a USDA Forest Service nursery near Medford, Oregon, began a pest management program following the guidelines we have outlined here. Among many achievements, they have begun a water monitoring program, tested innovating non-chemical pest control methods, improved public relations, and reduced their use of pesticides.

The Bug Vacuum. A vaccum machine was purchased in 1990 to remove lygus bug and cranberry girdler moths from seedling beds. It attaches to the front of a tractor and removes insects and other light debris from the crop by a hydraulically powered vacuum The nursery plans to use the vacuum when lygus damage is seen on seedling shoots or when threshold levels of cranberry girdler moths are caught in girdler pheromone traps. Tests still need to be run to compare vacuuming with insecticide treatments

Water Testing. The nursery has written and begun using a water monitoring plan. Both surface water and subsurface water are sampled and tested for pesticides and nitrates. Lysimeters (monitoring devices that sample water in the unsaturated zone above the water table) are used to sample subsurface water. The goal of the nursery is to be able to detect off-site movement of pesticides and nitrates via leaching or surface runoff.

Broccoli and Mustard. A cooperative research project continues at the nursery to look at the effects of different soil amendments on populations of soil-borne pests. Incorporation of sawdust, bare fallowing, and use of *Brassica* species, such as broccoli and mustard, as cover crops/soil amendments shows great promise in reducing populations of *Fusarium* spp, a fungus capable of causing widespread damping-off and root rot

Currently the nursery uses chemical fumigants to control fungi, insects, and weed seeds in the soil; fumigant accounts for over 90% of total pesticide used (pounds of active ingredient per year) in most forest nurseries, including the J. Herbert Stone Nursery. Due to the high risks associated with the application of fumigants and the quantities used (350 lb per acre), non-chemical alternatives such as cover crops are being tested.

Good Neighbors. A public meeting is held at the nursery each spring; neighbors and any interested individuals and groups are invited. At the meeting, the nursery staff describes the pest management activities that are planned for the up-coming growing season and invites comments and suggestions Nursery staff also notify each neighbor bordering on the nursery property prior to the application of fumigants.

Handweeding or Herbicides? In 1984, the Forest Service in Oregon and Washington was enjoined (prohibited by law) from using herbicides on all of its lands until a worst-case assessment of risks was prepared. The Forest Service nurseries were included in this ban. Weed control following the ban was by mechanical or manual means. In 1990, the ban was lifted and herbicides were again allowed on Forest Service lands The J. Herbert Stone Nursery, however, has continued to use hand-weeding in all seedling bed areas. Herbicides are used only along fencelines and other perimeter areas This has reduced the risk of herbicide exposure to employees working in seedling beds as well as injury to seedlings from herbicides

IPM in Motion. Figure 2 shows pesticide use (excluding fumigants) over the past 10 years at the J. Herbert Stone Nursery. Use of insecticides, herbicides, and fungicides has decreased from 10 to 15 lb/(a.i.) per acre in the early 1980s to less than 2 lb per acre in the last 2 years. The overall trend towards less is due to the loss of herbicides available for use between 1984 and 1990 and the current reduced herbicide program. It is also due to improved monitoring for diseases and insects resulting in less frequent and less extensive fungicide and insecticide treatments.

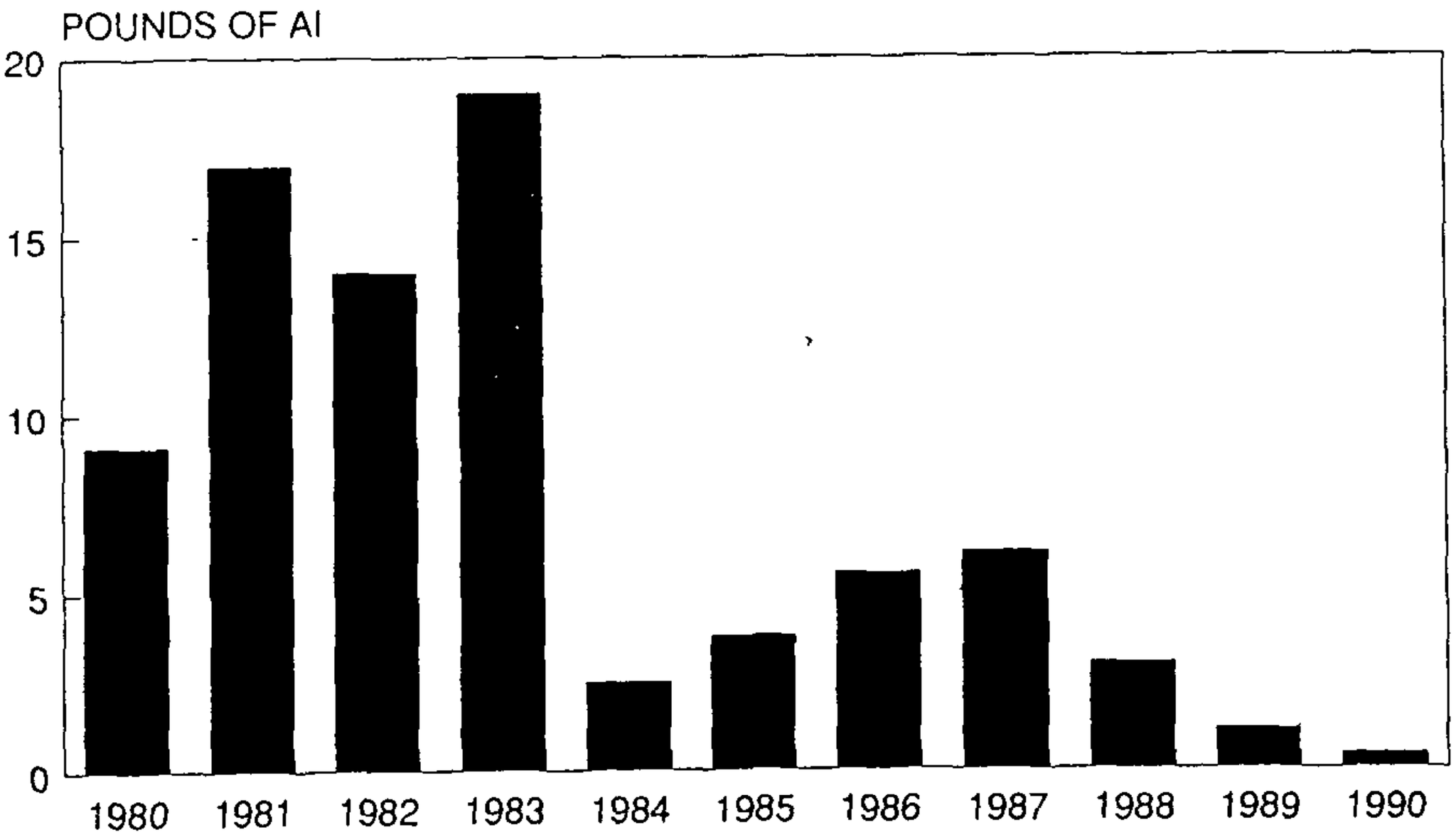

Figure 2. Pesticide use at the J Herbert Stone Nursery between 1980 and 1990 Fumigant use is not included A.I = Active Ingredient of Pesticide

The major challenge for the future for all Forest Service nurseries remains finding effective alternatives to fumigation as well as continuing to test and use non-chemical or less-toxic alternatives to insecticides, fungicides, and herbicides.

LITERATURE CITED

Pimentel, D., L. McLaughlin, A. Zepp, B. Lakitan, T. Kraus, P. Kleinman, F. Vancini, W.J. Roach, E. Grapp, W.S. Keeton, and **G. Selig.** 1991 Environmental and economic effects of reducing pesticide use. BioScience 41(6) 402-409.

USDA Forest Service. 1989 Nursery Pest Management Final Environmental Impact Statement Pacific Northwest Region, Portland, Oregon