Implementing Pest-control Strategies for Vocational and Therapeutic Greenhouses

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Summary. Managers of greenhouses used in vocational training or therapeutic programs often face pesticide use restrictions due to medical safety codes, possible sensitivity due to client medications, frequent presence of patient groups, or the added risk of exposure to clients with limited awareness. This review of three horticultural therapy programs emphasizes the practice of preventive measures, manual controls, and limited chemical methods to discourage pest problems and outlines pest control strategies that may not be feasible in commercial greenhouses. The importance and application of integrated pest management and biological pest controls are discussed. Procedures and client activities for sanitation, cultural controls, pest monitoring, and safe application of spray solutions are presented. Client work habits and skills may be developed using the tasks suggested for pest control, and various skill competency levels may be incorporated into the management scheme. The need for client training and task accomplishment may encourage alternative labor-intensive pest-control methods in therapeutic greenhouses.

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Greenhouses are effective training areas for persons with disabilities such as developmental disabilities, traumatic brain injury, spinal cord injury, mental illness, substance abuse recovery or visual impairments (Airhart and Tristan, 1987; Eddy and Sadof, 1993), but plant production in these confined environments usually creates greenhouse conditions conducive to insect and disease problems. Several factors influence the range of strategies available for greenhouses used in vocational training or therapeutic programs. The programs often have limited budgets that preclude purchasing expensive chemicals. Many programs consider training or therapy to be more important than production and are labor-intensive ventures that do not necessarily operate with commercial efficiency. Some programs have such a high client activity schedule that using chemical pest controls may be restricted or even prohibited. (Persons with disabilities in various horticultural therapy programs may be referred to as clients, patients, students, residents, or consumers depending on the location and purpose of the program. In this report, those persons being served are called clients.)

Pest control usually includes three basic strategies: prevention, exclusion, and eradication (Nelson, 1991). A grower must be able to spot and identify potential pest problems before they become damaging to the crop, know the pests and their life cycles, choose the proper control method, and apply the control measures at the right time.

Pest control usually requires storing, mixing, and applying chemicals that are not safe for human exposure (Carlson, 1986) and is often incompatible with client activity and training. Managers of vocational and therapeutic greenhouses must avoid exposing clients to dangerous chemicals, yet must maintain a high-quality product to satisfy consumer demand. Public institutions and conservatories that serve many diverse visitors must also limit pesticide exposure to reduce public concern and liability risk. The trend, where feasible, is to use fewer rather than many different pesticides and herbicides (Cagann, 1990).

Many commercial greenhouses today do not rely entirely on an eradication approach. Instead of regularly using chemicals, they use monitoring

techniques to track pest populations (Moore, 1990) and biological control methods to limit pest populations (Aylesworth, 1988), applying chemicals only when needed. But many growers have found that these efforts may be too labor-intensive or perhaps ineffective for certain crops in commercial growing operations (Broadbent, 1989). However, with the high level of supervised training required at vocational and therapeutic greenhouses, these techniques can reduce pest populations and enhance the clients' skill repertoire.

This paper summarizes strategies from three horticultural therapy programs. Bryn Mawr Rehab therapeutic greenhouse was designed to improve motion, balance, strength, memory, and socialization skills of inpatients and outpatients in a rehabilitation setting. Its purpose was to provide patients with activities and experiences that facilitate development, maintenance, and expression of appropriate physical and cognitive rehabilitation leisure lifestyles. Durfee Conservatory Horticultural Training Program specialized in at-risk youth by providing after-school programs that offered healthful activities as alternatives to substance abuse and violence. Basic work habits and new job skills were taught to build and improve self-esteem, and substance abuse issues were addressed. Reduced or total drug cessation and an interest in new activities were recorded for program assessment. Shipley Farm Horticultural Training Program provided vocational horticultural job skill training to adults with various disabilities. It was designed to maximize fictional independence and ease transition into the work force. Clients with various skill levels were trained with techniques such as task analysis, modeling, and verbal and written instruction appropriate to their cognitive abilities and physical capabilities.

The pest-control strategies from these programs were developed to shift the pest-control approach from eradication to prevention by incorporating client participation. The activities are labor-intensive and emphasize sanitation, cultural practices, strict observation, and recordkeeping as suggested by Dill (1991), yet are therapeutic due to the training and therapy programming goals. Biological controls and spot low-toxicity chemicals also were used in sustain-

able procedures used to manage pests below a visible plant damage threshold (Steiner and Elliott, 1987). These activities may not be suited to specific needs of all therapeutic greenhouses, but they can be partially incorporated to reduce dependency on chemical pest control and improve training.

Basic strategies

Many activities were designed to prevent pests by improving sanitation. Clients were taught to sweep and clean all work areas when finished with tasks and empty daily those trash cans containing dead or discarded plant materials. Lids were kept on trash cans to contain pests on discarded plants and weeds. Clients were instructed to moisten walks in greenhouses before sweeping to eliminate airborne dust and dirt. To help keep watering wands and hose nozzles off the floor, clamps and holders were installed near water spigots, and clients were instructed to use them after watering. Shelves were used for storing watering cans and pegboards and holders were provided for other tools to prevent them from being placed on the floor where diseases and pests thrived. When changing crops, clients were instructed to use a disinfectant solution to drench the benches and worktable tops. A siphon proportioner was used to create a dilute disinfectant solution for drenching gravel floors between crops and cleansing walkways.

All plant debris, yellowing leaves, and weeds in pots and under benches were eliminated, especially near entryways. For seedling culture, clients were instructed to wash hands frequently and handle plants carefully. Commercial greenhouses use rinse buckets with mild disinfectant solution for rinsing hands at entryways, between crop sections, or between greenhouses. Signs were posted at each entry to remind visitors that smoking and the use of tobacco products in greenhouses was prohibited for safety and disease prevention. Clients were taught to "think clean!"

Proper cultural practices could reduce the incidence of pests, and many activities focused on acquiring these skills. Clients were taught to use only clean potting substrate. Used pots and flats were sanitized for an hour in disinfectant solution, then scrubbed and rinsed in clear water. A corner bench was designated as a quarantine

area to hold new plants for 2 weeks before moving them to the greenhouse. Air movement was created with fan jets or box fans, especially on rainy or humid days and nights. Clients were taught to identify wilting plants or plants needing watering before fertilizing and to irrigate and fertilize in the morning or by early afternoon so that excess water could evaporate before evening. Clients were provided with spacer bars to ensure or check for adequate distance between pots.

Managers determined that some commercial liquid detergents and soaps were effective as regular preventive spray solutions for cleaning plants and controlling pests. Caution was required, however, because plants with hairy leaves were found to be susceptible to leaf burn during hot and dry conditions. Horticultural oils were also used for spot spraying, provided tender herbaceous foliage and stem axils were rinsed shortly after application. Two clients were instructed to use protective clothing and an electric power sprayer and became proficient using low-toxicity chemicals with direct supervision of a licensed applicator. Trainers and therapists used job-coaching techniques and breakdown of skills through task analysis. The time required for training varied with each client, but the end result was that all steps were learned by each.

Clients acquired improved observation skills. They were instructed to identify pests and taught to look where pests typically occurred on plants (e.g., mealy bugs at nodes, whiteflies under mature leaves, aphids and mites on terminal stems), where pests frequently gained entry or first became established in the greenhouse (near entryways, vents, or coolers, in corners, on weeds under benches), and which plants were most susceptible to certain pests. Large color pictures of pests and their names were posted in the classroom for review. Since most pests move from plant to plant, clients were instructed to search daily to find any plants with pests. Clients were taught that, when monitoring for pest populations, they should check plants regularly and frequently. Walkside and wallside areas were identified as two key locations for monitoring infestations in greenhouses. We used a random selection of leaves and stems from the top, middle, and lower portions of the plants, being sure to observe the

lower surface of leaves. Clients were taught to use a hand-held 10× or 20× magnifying lens to help them identify most pests.

Rogueing plants was an effective pest-control method. By removing and discarding infested stems or whole plants as soon as the pests were observed, many serious problems were eliminated early. Some infested plants were moved from the greenhouse to the quarantine area to receive continual care until they were insect free, then returned to the greenhouse. Clients were given flags to place in infested areas to remind everyone to continue looking in that area. Pruning and pinching were regular activities for controlling plant shape and size to maximize air circulation, adequate light, and healthy growth.

Health and safety concerns had to be accommodated when insect populations became severe, and a few chemical controls were used with caution. Because the therapeutic greenhouse was directly attached to the hospital unit, all clients and visitors were absent and the separating doors were sealed completely before releasing aerosol canisters. All re-entry and ventilation regulations associated with the aerosols were followed.

Programming scheme

Daily assignments were written and posted as a low (1) to high (5) priority for the day, and some tasks were assigned to two or three clients at once. Depending on the production schedule, tasks were classified as requiring low, moderate, or high skill levels to help clients attain advanced status in the program. Assigning skilled clients to assist new or less-skilled clients raises the self-esteem of the assisting client and provides additional programming support, training, or supervision without adding staff (Airhart and Tristan, 1987).

Nonchemical pest control

Clients with higher skill levels and dexterity can control pests on individual plants manually—hand picking

caterpillars and grasshoppers, brushing aphids into soap solutions, using cotton balls with rubbing alcohol to swab mealy bugs or wipe scale insects, or repeatedly dipping into warm, soapy water those plants with spider mites.

Another technique taught to clients was using a vacuum cleaner to control mobile pests (e.g., whiteflies, mites, fungus gnats). Cheesecloth was placed over the nozzle end to prevent leaves from being damaged. Bright yellow plastic picnic plates were smeared with sticky trap compound or petroleum jelly to trap individual pests; some were hung by string just above the plant canopy, others were stapled to large wooden labels and placed in the pots. With regular inspection, these allowed clients to monitor enlarging pest populations. Black light and electronic traps were used at night and attracted moths and butterflies that would lead to larval problems. For poinsettia basket production, white plastic or aluminum foil was placed on the floor between rows of pots to confuse pests and discourage their entry into the crop area, but the effectiveness was questionable. The white plastic seemed to improve the light level in the crop canopy.

The standing collections and permanent displays at the conservatory program allowed the use of long-term biological control strategies, especially in the upper canopy where spray applications were difficult. Various predator and parasitic populations were released and have maintained a satisfactory balance of host-pest and beneficial insect control, e.g., *Encarsia* wasps for whiteflies, *Cryptolaemus* larvae for mealy bugs, lady beetle or *Aphidoletes* larvae for aphids, and *Phytoseiulus* for spider mites (Muttart, 1989).

We have presented collaborative strategies of pest and disease control that emphasized three factors: 1) safety of the public, staff, and clients; 2) maintenance of plants in saleable and decorative condition; and 3) activities designed for client participation and training. Our conclusions from observations of client behavior and skill acquisition during these activities were

that they were effective in raising self-esteem and providing clients with appropriate work habits, job skills, and employability. The programs sponsored holiday-season open house hours to which the public and representatives from the funding agencies were invited. Clients served as sales agents and tour hosts, explaining the crops and production techniques to visitors. Visitors provided positive and external reinforcement to the clients through the comments and praises they shared during their visits, allowing clients to learn that their efforts and products were valuable to the public.

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