



## A Study On Biological Control, Cultural Practices, And Chemical Control Methods In Nursery Pest And Disease Management

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### ABSTRACT

This study explores integrated pest management strategies in nursery settings, focusing on biological control, cultural practices, and chemical control methods to effectively manage pests and diseases. The nursery environment, crucial for plant propagation, is susceptible to various threats that can compromise plant health. Biological control methods involve the introduction or enhancement of natural predators and beneficial organisms to regulate pest populations. This eco-friendly approach aims to establish a balanced ecosystem, reducing reliance on chemical interventions. Cultural practices, such as proper sanitation, crop rotation, and selecting disease-resistant plant varieties, play a pivotal role in preventing and managing pests and diseases. These practices create unfavorable conditions for pathogens and pests, contributing to a healthier nursery environment. In order to effectively manage pests and illnesses, this study examines integrated pest management strategies in nursery settings with an emphasis of biological control, cultural practices, and chemical control measures. Plant propagation depends on the nursery environment, which is vulnerable to a number of risks that could jeopardize the health of the plants. In order to control pest populations, biological control approaches entail introducing or enhancing natural predators and beneficial species. By creating a healthy ecology, this environmentally friendly strategy seeks to lessen the need for chemical interventions. Cultural techniques are essential for controlling and preventing pests and illnesses.

**Keywords:** Biological, chemical, techniques, environment, pathogens, pests

### INTRODUCTION

Effective mitigation of pest and disease in nurseries requires a comprehensive approach that incorporates biological, cultural, and chemical control strategies. In order to maintain a healthy ecosystem, biological management uses natural predators, parasites, or pathogens to control pest populations. To make an environment less conducive to pests and illnesses, cultural control entails changing nursery practices, such as crop rotation or the selection of pest-resistant plant species. As a last option, chemical control uses pesticides to specifically target and eradicate infections or pests. By reducing the need for chemical interventions and increasing the nursery ecosystem's overall resilience, incorporating these techniques promotes a strategy that is both environmentally friendly and sustainable. This comprehensive strategy promotes a harmonic balance between ecological sustainability and pest and disease management, in line with contemporary agricultural methods (Brzozowski & Mazourek, 2018).

### HISTORY OF NURSERY DISEASE AND PEST MANAGEMENT

Nurseries diseases and pest management have changed over the years, embracing a wide variety of biological in nature, cultural, and chemical control techniques. Crop rotation and the choice of disease-resistant varieties were two examples of the cultural techniques that were a major part of early agricultural operations. These conventional methods sought to minimize the transmission of illness and disturb the life cycles of pests (Warrior et al., 2002). In the middle of the 20th century, chemical control techniques became more popular with the introduction of modern agriculture. As a fast and efficient way to fight illnesses and pests, pesticides gained widespread use. However, a move toward integrated pest management (IPM) in the late 20th century was spurred by worries about the effects on the environment and chemical resistance (Parella, 2007). Biological management techniques have become a viable substitute by utilizing diseases, parasites, and natural predators to manage pest populations. In nurseries, the introduction of microbiological agents and beneficial insects became essential to maintaining ecological equilibrium. Furthermore, it was shown that maintaining good hygiene and plant spacing, among other cultural practices, was crucial to preventing pests and diseases. Growing emphasis has been placed in nursery management on organic and sustainable practices in the last few decades. In order to improve natural pest management, this entails reducing reliance on artificial chemicals, boosting soil health, and encouraging biodiversity. The integration for biological, cultural, and restricted chemical treatments is currently regarded as a comprehensive strategy that guarantees the long-term well-being of nursery environments while efficiently controlling pests and illnesses (Tariq et al., 2020).

## **EXPLORING INTEGRATED APPROACHES**

### **Biological method**

It helpful in utilizing organisms to lower insect and mite pest populations in a Nursery is known as biological approaches. Introduction of bio-control agents like as predators mites, pirate bugs, soil-dwelling the mites, and parasitical insects can be used to biologically manage pest insects and mites in nurseries.

### **Insect parasites**

An organism that targets and eliminates a single host is called a parasite or parasitoid. Usually, the parasite finishes all or a portion of its entire lifespan on one particular pest.

### **Predator**

An insect or mammal related to an insect that targets or lives on an individual or specific pest is called a predator. Usually, a predator's natural feeding cycle includes this attack. The most prevalent predator in greenhouses that feeds on aphids is the ladybird beetle. Aphids, scales, mealybugs, thrips, mites, and insect eggs are the food sources for lacewings. Aphids and little ants are consumed by the larvae of syrphid flies, sometimes referred to as "flower flies."

### **Formulation of Biological control agents**

It is possible to create biological agents, like as predators and helpful bacteria, for the purpose of managing pests and diseases in nursery environments and fungi such as *Trichoderma harzianum* and etc. To increase the shelf life and effectiveness of these formulations, the active organisms are frequently stabilized or encapsulated in neutral carriers or nutritional media. Examples include predatory insects or mites used to suppress pest populations, as well as microbial biopesticides comprising bacteria or fungi targeting particular pests or diseases (Wardlow et al., 1992). By ensuring the viability and focused on administration of these biological agents through proper formulation, nurseries can manage pests and diseases in a sustainable and environmentally friendly manner.

### **Cultural pest control**

It refers to methods or activities that either promote crop development or make a pest's (such as insects, Diseases, or weeds) habitat—in this example, the greenhouse climate used for crop production—less conducive to a pest. Cultural control is most often applied as a preventative approach.

### **Controlling the Physical Environment**

The well-being of crops and the pests that harm them are influenced by environmental parameters like sunlight, temperature of the air, plant humidity, temperature, air circulation, medium composition, pH, electrical conductivity, and crop nutrition. Because environmental controls have a simultaneous impact on crop yield, their application to disease management is complicated. Plants that are consistently stressed, such as those grown in excessively dry or wet environments, are more vulnerable to disease pathogen attack.

### **Weed control**

Weeds take over plants that provide food, space, and other necessities, therefore prompt weed control is required. Cover crops, mulching, and chemical application are methods used to control weeds. weedicides that prove useful are pre-emergence products like Baseline or post-emergence products like 2,4-D and Roundup. Biological control of weeds in a nursery involves using natural enemies such as insects, pathogens, or herbivores to manage weed populations. This method relies on the principle of introducing or encouraging organisms that naturally feed on weeds, thus reducing their abundance without the need for chemical herbicides. Common biocontrol agents include insects like weevils or beetles, fungi, and bacteria specifically targeted to attack weed species. However, careful consideration is necessary to ensure that introduced organisms do not become pests themselves or disrupt the ecosystem balance. Regular monitoring and integrated pest management techniques are essential for successful biological control in nursery settings. Biological control of weed in a nursery refers to the management of weed populations by natural enemies, such as insects, diseases, or herbivores. The idea behind this approach is to reduce the number of weeds without using chemical pesticides by introducing or promoting creatures that prey on them naturally. Typical biocontrol agents include bacteria that are specifically designed to combat weed species, fungus, and insect like weevils or beetles. To make certain that introduced organisms don't turn into pests themselves or upset the equilibrium of the environment, nevertheless, considerable thought must be given to this. Integrated pest management strategies and routine monitoring are necessary for effective biological control in nursery environments.

### **Chemical Method and Mechanical methods**

The main disease affecting nurseries stage plants is damping off, which may be controlled with appropriate cleanliness practices and the application of treatments such as 50% ethyl alcohol, 0.2% calcium hypochlorite, and 0.01% mercuric chloride. Most of the seed treatments are as follows, and they are administered for five to thirty minutes.

### **Disinfection**

Mercuric chloride or formaldehyde hot water are used to eradicate the infection inside the seed. Treatment of hot water Dry seeds are soaked in hot water between 48°C and 55°C for ten to thirty minutes. Safeguarding during treatment in the dry sea Agellal, aretan-6, and tafasan-6 are examples of non-mercuric and mercuric compounds found in oregano. To do this, shake the seeds inside the seed container. In the wet approach, the seeds are submerged in a liquid solution for a predetermined amount of time.

### **Treatment of the soil**

Plant growth and development are impacted by weeds, nematodes, and hazardous fungus that are present in the soil. Heat or chemical treatments can get rid of them. In order to do that, the soil is heated for 30 minutes to a temperature of roughly 60°C in order to disinfect it. Chemical processing Formaldehyde, methyl bromide, chloropicrin vapam, and other chemicals are used to treat diseases like rust, powdery mildew, leaf spot, and bacterial blight. In addition, yellow vein mosaics are seen in the Bordeaux combination used to treat these illnesses with carbendazim and redomil. You can also experiment with the bio-fungicide *Tricoderma viridi*.

## **HOLISTIC STRATEGIES FOR NURSERY MANAGEMENT**

In the dynamic realm of nursery management, an exhaustive investigation underscores the perpetual nature of problem-solving within this domain. One persistent challenge in this context is the presence of pests. Traditionally, nursery managers have often adopted a reactive approach, awaiting the visible manifestation of pests or diseases before resorting to the use of potentially harmful chemical sprays for eradication. The concept of "holistic" pest management represents a paradigm shift in this approach. This proactive strategy involves an interconnected set of techniques deployed throughout the nursery culture, considering not only the immediate issue but also the overall health of the plants and the nursery environment. Emphasizing a comprehensive and anticipatory perspective, holistic pest control aims to prevent issues from arising and addresses them sensibly if they do. Comprising four interrelated strategies, this approach necessitates a harmonious collaboration between these components for optimal effectiveness (Wescom, 1999).

The four pillars of holistic pest management in nurseries encompass: firstly, Issue Prevention Through Cultural Measures, involving the maintenance of hygienic conditions, effective management of the nursery environment, appropriate task scheduling, and the promotion of plant health. Secondly, the Identification and Diagnosis of Problems rely on keen observation, meticulous documentation, and precise problem-solving techniques. Thirdly, Problem Management requires the implementation of prompt and suitable pest control procedures, while also emphasizing the importance of maintaining a balance between pest populations and beneficial insects and pest predators. Finally, Continuous Process Evaluation serves as a critical aspect, ensuring ongoing improvement in the efficacy of pest management techniques and the acquisition of valuable insights from practical experience.

## **HOLISTIC APPROACH APPLICATION IN NURSERY**

### **Prevention of disease and pest through sanitation**

It's imperative to keep insects outside of a nurseries in the first place. Since there are no pests in a container nursery environment at first, the most sensible way to manage illnesses is to keep pests out of the growing area in order to prevent infections. The following are the main entry points for pests into the growing area: Wind: Spores, which seeds, or insects in the air can be brought in by means of the ventilation system. Water: Irrigation water can bring weed seeds, fungus spores, and cryptogam spores. Expanding Media: Although the majority of commercial mixes are regarded as "essentially sterile," certain types of growing media or their constituent parts have been found to contain potentially hazardous fungus. Receptacles. Reusable containers may hold residual growing material from past crops, plant roots harboring pest propagules, moss, or algae. Surfaces inside the Forming Architecture: The growing area's floors, benches, and other surfaces could be home to pests from the crop that came before. Propagation Resources. Sometimes the infection spreads before the seedlings, transplants, or cuttings arrive at the nursery. Grow Media with Transported Soil: Infested materials may enter a growing area on workers' or visitors' shoes, tools, or other equipment. Pests on the Move: The growing area is directly accessible to rats, birds, and insects (Ogle et al., 1997).

### **Effective Crop scheduling**

A crucial element of comprehensive pest control is crop scheduling. Many types of plants with varying development rates are grown at a normal native plant nursery. Plants that develop slowly must be started first to give them the most time to mature. Rapidly growing species should be planted afterwards in the season to avoid becoming "top-heavy" and rootbound. Overgrown plants in their pots are more vulnerable to stress and pest issues. Overgrown, leafy plants that are "leggy" might contain insects along with additional pests that can infect the remaining crop.

### **Maintaining the Health of plant**

Starting with healthy crops is an essential part of any pest control approach, and it's especially important for holistic management. In addition to being better equipped to withstand environmental challenges, healthy plants are also more resistant to fungal infection and insect and other pest attack. A substantial portion of this tolerance can be ascribed to physical traits like the foliage's thick, waxy cuticle, and some people think that healthy plants also have chemical defenses.

Daily Observation and Proper Documentation: Regular "scouting," or observation, is an essential component of the integrated strategy. While they are still little and readily fixed, daily walks across the nursery will show emerging insect outbreaks or horticultural issues that attract pests. Crop monitors should take a close look at every species being cultivated, note the greenhouse's temperature and environmental controls, and make further observations. Every component of the nursery, including a nursery, rooted chambers, and outdoor nursery, require the establishment of a monitoring and record-keeping system. When organizing the following crop, these records are crucial for preventing insect issues in the future.

### **Precise problem identification**

It is imperative for nurseries managers and diseases scouts to promptly and properly detect issues before they cause substantial harm. Abiotic pressures usually create more issues than biological pests like fungi and insects, even though biological pests are constantly present. It takes experience and training to diagnose diseases, thus nursery personnel should be trained to recognize abiotic injury incidents as well as new problems immediately. Employees who regularly work in the expanding region are best positioned to identify such issues before they worsen or spread.

### **Quick and suitable control methods**

The limited use of chemicals is a fundamental principle of holistic pest management. The use of chemical pesticides ought to be reserved for situations in which no other environmental or horticultural controls remain viable. There is a misconception among many individuals that any organic or natural pesticide can be used without risk. Many approved botanical insecticides have the potential to be hazardous to users or the environment.

### **Promoting beneficial Organisms**

Using beneficial fungi, insects, and other creatures to assist avoid pest impacts on crop plants is known as holistic management. The majority of individuals employed in nurseries are aware of mycorrhizal fungi and their numerous advantages for the host plant, such as defense against root diseases. Mycorrhizal fungi are frequently highly host-specific, however there isn't much information available for a lot of native plants.

## **OPTIMIZING NURSERY HEALTH:**

### **Investigation of Biological, Cultural and Chemical control techniques**

Improving the health of nurseries is a complex process that requires a thorough analysis of biological in nature, cultural, and chemical management methods. It is essential to comprehend the nuances of each strategy and successfully combine them in order to grow strong, healthy plants. The goal of biological control techniques is to manage illnesses and pests by utilizing nature's natural defenses. Use of beneficial insects, like ladybugs or predatory nematode may help in controlling pests without the need for chemical treatments. This eco-friendly method encourages a healthy ecosystem in the nursery. Cultural customs are essential to preserving the health of nurseries. Keeping tools and equipment clean on a regular basis is one way to avoid the transmission of infections through proper sanitation practices. Furthermore, using crop rotation and choosing resistant plant kinds (Warrior, 2002). Despite their effectiveness, chemical control strategies should be used carefully to reduce their negative effects on the environment. It is essential to choose pesticides carefully, taking into account both their range of targets and probable harm to beneficial creatures. The need for extensive chemical treatments can be decreased by routinely monitoring insect problems and taking early action to stop them from getting worse. Combining these three control methods creates the best possible plan. Nursery health may be maintained at its best by combining biological approaches to naturally control pests, cultural measures to stop the spread of disease, and the sparing use chemical controls when needed. In addition to protecting the plants, this all-encompassing strategy supports environmentally conscious and sustainable nursery management. In summary, achieving optimal nursery health necessitates a sophisticated comprehension and fusion of chemical, cultural, and biological management strategies (Kruidhof et al., 2020).

## **BALANCING ACT**

### **Examining the triad of strategies for effective Nursery Management**

A careful balancing act is required for effective nursery management because it must traverse the complex triangle of tactics that are necessary for good operation. First and foremost, creating a loving environment is crucial. Establishing a secure and engaging environment for early learners is essential. This includes thoughtfully planned classrooms, developmentally appropriate supplies, and committed employees with early childhood education training. Second, it is essential to have a strong curriculum that is suited to early growth. Comprehensive growth is ensured by matching activities to social, cognitive, and emotional stages. A successful nursery program is built around the integration of learning through play, sensory overload, and language development activities. Finally, it's critical to communicate with parents. Building open and frequent communication channels for information on a child's development strengthens the bond between the family and the daycare. Essentially, the combination of establishing a supportive atmosphere, putting in place a customized curriculum, and encouraging candid contact with parents is what makes a nursery successful. Achieving this triangle provides a strong basis for an individual's holistic development in addition to ensuring the nursery runs smoothly.

### **In- depth Analysis of pest and disease control in Nurseries**

#### **Biological, cultural and Chemical Solutions**

Controlling pests and diseases in nurseries requires a multidisciplinary strategy that includes chemical, cultural, and biological remedies. By feeding on dangerous pests, beneficial species like nematodes or predatory insects help preserve a natural balance in the biological system. Cultural methods include maintaining ideal moisture levels, allowing for sufficient air, and spacing plants properly to reduce the likelihood of disease. The nursery's defense is further strengthened by choosing plant kinds resistant to disease. But when these methods are insufficient, careful application of chemical solutions is necessary. Natural sources of organic pesticides provide an environmentally acceptable substitute that targets pests with the least amount of impact to beneficial creatures. Conventional chemical pesticides, on the other hand, are effective but must be applied carefully to minimize any possible negative effects on the environment.

#### **CONCLUSION**

In summary, an innovative approach to managing diseases and pests in nurseries emerges from the harmonious integration of biological, chemical, and cultural management methodologies. Biological control harnesses the power of naturally occurring predators, parasites, and pathogens to maintain ecological balance, thereby mitigating the adverse environmental impacts associated with chemical interventions and promoting sustainability.

Strategic application of chemical control methods serves as a valuable tool for swiftly addressing pest and disease outbreaks, provided it is executed with care. Prioritizing formulations that specifically target pests while minimizing harm to non-target organisms and ecosystems is essential for ecological preservation. Integrated Pest Management (IPM) principles serve as a guiding framework for the judicious and equitable use of chemical solutions. Cultural management practices, such as crop rotation, hygiene protocols, and habitat modifications, play a pivotal role in both preventing and suppressing pests and diseases. By embracing these multifaceted strategies, nurseries can establish resilient defense mechanisms against threats while fostering ecological harmony and sustainable agricultural practices.

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