INTEGRATED ARTHROPOD PEST MANAGEMENT IN PLANT TISSUE CULTURE PRODUCTION

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Arthropod pests commonly associated with plant tissue culture production include thrips, mites, ants, and cockroaches. The first two are particularly troublesome for several reasons. First, their small sizes allow them to go undetected for a long period of time. Second, they have a tremendous reproductive ability and can build up to large numbers within a relatively short period of time. Last, they often are found infesting tubes and jars inside the incubation area which may necessitate destruction of a large portion of the stock. The other two, ants and cockroaches, are frequently found in transfer rooms and surrounding outside areas. They are largely scavengers and may be physically excluded from buildings.

BIOLOGY AND IDENTIFICATION

Thrips. Several thrips species may be found infesting tissue culture plants. Of the more common are the western flower thrips, *Frankliniella occidentalis* and the onion thrips, *Thrips tabaci*. Thrips are minute, slender insects which vary in color from tan to dark-brown or black. They possess a pair of feather-like or fringed wings which they hold flat over the body when at rest. Eggs are laid in plant tissue. There are two nymphal and two resting (pupal) stages. Life cycle can be completed in 3 weeks or longer depending on the species. Thrips damage plants by scraping the tissue with their single mandible and lapping the juices. This activity usually takes place in the protected, growing tips of the plant. When the tissue expands, leaf deformities and cupping are evident as a result of feeding by thrips.

Mites. Mites are the other troublesome group of pest arthropods found in tissue culture production. Mites are not insects. They can be separated by lacking wings and possessing one body segment and four pairs of legs (with the exception of gall mites which have two pairs of legs). Insects have three body segments and three pairs of legs, and they may or may not possess wings. Dust or fungus mites are usually found in containers in the incubation room. Even *though some may be airborne, it seems that the majority of infesta*tions become started through passive movement on workers clothing and other infested materials.

MANAGEMENT STRATEGIES

Several tactics must be employed when devising an integrated pest management strategy. A combination of physical, cultural, and chemical methods must be carefully tailored for individual situations.

Physical Methods. The foremost concept of physical management is exclusion. This means that barriers must be used to prevent the pest arthropod from gaining access to the growing environment. Screens must be installed on vents to prevent entry. Regular window screens or fiberglass screens may not be appropriate due to their coarse texture. Finer-mesh screens such as paper filters (5 μ) or 200-mesh cloth screens must be used to insure exclusion of small insects such as thrips. Screens should be changed as needed, perhaps as often as once a month.

Evaporative coolers tend to introduce insects in their air stream from the outside environment. Therefore, the use of internal coolers is preferred to eliminate that route of pest introduction. Recirculating air filters (such as "Hepa" filters) also are useful in trapping dust, particulate matter, and other contaminants in the transfer room. This will allow for a cleaner environment and a lesser chance of contaminants being introduced into the incubation room.

Cultural Methods. Sanitation or asepsis are imperative to any tissue culture production operation. Use of sterile techniques, especially in the transfer room, would prevent establishment of several contaminants (1, 3, 4). The use of clean stock also reduces the chances of introducing a foreign organism into the culture.

Worker clothings must be regularly cleaned and thoroughly inspected before entry into the incubation room. Workers with bright colored clothes should be required to change their clothes before entering transfer or incubation rooms. Bright colors, especially yellows, are attractive to flying insects which may then be passively carried indoors.

Temperature regulation and air circulation also are important cultural factors. Extremely high temperatures are undesirable since they result in plant stress, as well as being conducive to rapid arthropod population increases. On the other hand, extremely cool temperatures may retard plant growth and development. Therefore, the proper temperature range for the plant species should be maintained as well as an appropriate air flow which results in an equitable temperature distribution.

Monitoring pest arthropods is another crucial cultural practice. Periodic visual inspection of containers will reveal infestations early. Additionally, flying insects, such as adult thrips may be attracted to yellow sticky cards hung in the transfer and incubation rooms. These cards must be monitored weekly for infestations and changed as needed. It is important to keep in mind that the cards are

being used as an early indicator of infestations. They cannot be relied upon for complete control by attracting all thrips since the wingless immatures are feeding inside the containers. Once an infestation is detected, appropriate chemical control or disposal of stock must be carried out for eradication.

Chemical Control. Pesticides may be used against arthropods, either as a preventative or a curative measure. Indoor foggers (such as "Holiday," "Black Flag," etc.) may be used once a month in the transfer room. They usually contain a pyrethroid insecticide which results in quick kill. The carrier particles, however, may clog up the recirculating air filter. Therefore, it is advisable to turn off the filter prior to fogging over night. Systemic insecticides may be incorporated in media if they are stable under autoclaving. A successful example of this use was given for the insecticide acephate (Orthene) by Klocke and Myers (2). They reported excellent control of thrips, *Allothrips* sp., with as low a concentration as 10 parts per million.

The use of fenbutatin-oxide (Vendex) for mite control has been reportedly successful. Various growers have experimented with painting shelves with a Vendex paste for mite control. Results seemed acceptable when this was carried out every six months. However, neither acephate nor fenbutatin-oxide are currently registered for such uses.

Finally, ants and cockroaches may be excluded from indoors by sealing all cracks and crevices and following sanitary procedures. External perimeter applications of pyrethroid insecticides such as cypermethrin or permethrin will repel ants for long periods. Boric acid powder ("Roach Proof") has reportedly been successful for cockroach control when applied alongside bases of walls and shelves. "Combat" bait stations also may be effective against cockroaches indoors.

It appears from the above that proper physical and cultural practices should suffice to prevent an arthropod infestation. Chemical control may be used when a large infestation is detected or when destruction of the crop is not feasible.

LITERATURE CITED

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