QUALITY ASSURANCE AT THE GROWER LEVEL, A NORTH AMERICAN PERSPECTIVE

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As the biological control industry continues to mature worldwide, acceptance, respect, and reliance on our industries' products has also grown. Growers at the start of this new millenium are now not only familiar with beneficial insects and mites, they have definite expectations of performance. One of their main indicators of expected performance is the inspection that they make when they receive the beneficials.

The purpose of this paper is to discuss simple and easy methods of analysis that the growers or their employees can use, which will establish a level of "Quality Assurance" that can imply the integrity of the product when received by the grower.

Only a few of the growers are aware that our industry has a very complete set of Quality Control Guidelines. These guidelines are still best represented by the IOBC QC Proceedings, produced in 1993, in Rimini. Many of the commercial insectories around the world are active participants in the IOBC process.

For practical purposes however, at least at the grower level, most of these tests are too time consuming and require specialized equipment such as microscopes, temperature controlled chambers, etc.

The remainder of my report is divided into two parts. In the first part I will discuss the Producer/Distributor role in Quality Assurance. In the second part I will present simple techniques that the grower can use to verify that the integrity of the product has not been compromised during the handling and shipping process.

Part 1: The role of the Producer and the Distributors.

The producer and its distributors need to inform the customers that Quality Control standards exist and are being complied with. The grower should be made aware of the standards and the technical sales people should explain the purpose of the tests. The company should also make it clear that when substandard product is identified it will do its utmost to determine the cause and replace any defective (dead) product the grower may have already received.

For many products, such as *Phytoseiulus persimilis*, freshness is an essential factor. At Applied Bio-nomics, we date the time sensitive products based on the date of packaging. This critical date has forced our distributors to rotate our stock and reduce carry-overs. Best before dates are the next best thing but, in our experience, they become an excuse for a carry over of stock. There is good evidence that *P. p*. can be effectively stored for up to three weeks, but no one can successfully argue that storage is preferred, because of the limited lifespan. In addition to the

excellent IOBC standards, producers must always challenge the design of their culture and the effectiveness of their product at the grower level. Care must be taken to ensure that selective pressures are appropriate for the final use of the beneficial. This is a very serious issue that, in my opinion, supercedes the Quality Standards currently being used. Using *P. p*. as an example; many producers, in an effort to maximize production and increase measurable quality, have found that eliminating the stress of greenhouse production has a significant positive impact on culture yield, consistency, and stress related disease symptoms. The result is that many of the largest producers are now growing *P. p*. in buildings with artificial light. Generations of *P. p*. have now been spared the test of gross temperature and radiant heat fluctuations and, as a result, run the risk of losing their ability to control the pest in a harsh, glasshouse environment.

Many predators are reared using a substitute host. *Amblyseius cucumeris* is not raised on thrips but is sold as a control for them. Producers must be able to show that their culture has not lost its interest in thrips. This can be a very difficult test and usually requires field testing to show efficacy in the crop. Almost all of the producers of *A. c*. now produce the "non diapausing" strain. In order to make such claims and in order to ensure that the trait is maintained, it is essential that, from time to time, the culture be tested under normal diapausing conditions.

Producers must also ensure that any specialized pest, such as tomato adapted spider mites, are securely dealt with during the production process to prevent these "super pests" from getting out of their systems and onto the growers crop.

Predatory bugs such as *Dicyphus hesperis* and *Orius* sp., are frequently reared on frozen grain moth eggs. Care must be taken to ensure that these predators do not become sedentary egg predators in the growers' houses.

This is not to say that selective mutations are common in commercially reared cultures, but prudent producers must always question the selective pressures that they design either intentionally or inadvertently into their systems.

Producers can also design packaging to help growers ascertain quality. Using *Aphidoletes aphidimyza* as an example, if the growers are able to hold the pupae in the package until they emerge, it will not only prove to the grower that the product is viable, it also allows higher emergence because the humidity is better controlled. Well designed packaging keeps the pupae away from ants and other predators and enables the grower to anticipate the timing of the subsequent generation. If the container is well designed, it will enhance mating because of the close confinement within the package.

Producers of parasites should be ensuring that the actual host that they are using is the same as the intended target. While many parasites have a wide host range, most do best on the original host. Producers should constantly be working with their customers to let them know what host that they are using and to find out if new pests are becoming more significant. A shift in host pest may have a tremendous impact on the parasites' performance in the field.

The producers' packaging and shipping people are of critical importance. They are the final step of quality control. How many cool packs and where to put them are critical decisions? Cold packs cause condensation which can be more dangerous to the beneficials than the warm temperatures that the producers were trying to avoid. Many North American producers are now experimenting with temperature recorders and temperature sensitive tags that indicate minimums or maximums.

Some products are not compatible with others in a confined space. Active *Stratiolaelaps scimitus* cultures may suffocate more delicate wasps such as *Aphidius* when they are shipped as live adults.

Part 2: The Role of the Grower and the Employees

Without a doubt, the most difficult time in a beneficials' life is during transport, where, upheaval of natural rhythms, unnatural densities, restricted oxygen supplies, condensation, and temperature extremes, can adversely affect quality.

The single most important step for the grower to take, is to unpack the beneficials and rescue them from their confinement within the shipping container. With the products laid out on the table in front of the grower or employee, they can assure themselves of the quality of the products received.

All senses should be employed during the evaluation process. Did the shipment arrive late? Is it unusually hot or cold today? Is the package damaged? These questions will suggest possible problems that need to be checked. When the package was opened was it hot inside? Did it smell bad? Was the ice still frozen? Did any of the contents shift and crush some beneficials? Is everything soaking wet? After assessing the shipment as a whole, the grower should evaluate each of the products received. For some products, such as predatory mites or beetles, this is a short term test where motion indicates life and fitness, and a simple count confirms numbers. For other products such as parasitic wasps or midges, emergence needs to be confirmed, which necessitates a longer period of assessment.

The following are generic tests that we employ when shipping and these can also be used at the grower level. Tests for a particular type of beneficial are listed in the order of simplicity and time required to do them:

A. Predatory mites in a granular carrier; *i* - take container out of the shipping carton, invert it and place it down hard on the table, knocking the carrier and mites down. Leave for 1 minute and observe motion of mites. Leave for 10 minutes and inspect top of container. Active mites seen at the top are known to be alive and with an experienced eye, quantities can be ascertained. The relative rate of motion at the one minute inspection can be a good indicator of the relative fitness of the entire container. If you are not satisfied by these results proceed to *ii* - gently, but thoroughly, mix the entire container. Take a small, but representative sample (eg. 10 to 20%) and pour it out onto a piece of white paper. Gently disturb the material while squishing the mites. The speed of the mites and their dispersal should be

observed. The tester can either count as they squish or, at the end, dump the carrier onto another sheet of paper and count the squish marks. If the mites need to be conserved, this test can be performed using a fine paintbrush. Remove the mites with it and put them back in the container. If this method still does not assure the grower of the quality, then microscopic examination of the already dumped carrier should indicate if there are any mites there at all. Non-moving mites should not be considered dead for at least another hour, as reaction to poor air supplies or temperature extremes can cause them to stop moving.

B. Predatory mites on a leaf carrier; examine leaves for signs of freezing. With a hand lens of at least 10X or a dissecting microscope, look for mobiles and eggs. Many mites are difficult to see in some lights. *P. p*. for example, is very difficult to see under the yellow tinted plant grow lights.

C. Predatory mites in a bran carrier; gently mix by rotating the contents of the container. Without delay, open the top of the container and count the number of "fast moving" mites on the bottom of the lid. At Applied Bio-nomics, we use filter paper to seal *A. c*. Over time we have been able to correlate the presence of 3 "fast moving" mites to a count of 50,000 per liter. Counts of 2 or less usually show an under-count while 3 or more seldom result in an under-count. If the grower is using the product regularly, then this method will assure him or her that the count is acceptable, the container did not freeze, they did not run out of food (by the presence of bran mites on lid), and the culture appears healthy (by the speed at which they travel). For larger mites, such as *Hypoaspis miles*, a well mixed sample can be poured out onto a hand or piece of paper. After a few seconds the sample can be poured back into the container and the hand or the paper can be inspected for predatory mites and food.

D. Beetles and Predatory Bugs; chill the container for at least 15 minutes to slow the bugs. Quickly open container and dump out bugs onto a sheet of white paper. Count the individuals on the paper and estimate the number remaining in the bottle. This check should be done right in the glasshouse where release is desired because they will be very difficult to contain.

E. Predatory Midges in pupae form; allow adults to emerge in the container. Mark off a representative area on the container, about 10%, and count adults in the grid. *A. a*. tends to evenly space themselves as adults, so counting can be quite easy and accurate. The grower should not attempt to evenly subdivide the carrier prior to emergence as *A. a*. pupae tend to clump together.

F. Parasitiods in pupae form; *i-* on cards: at the grower level, emergence is the only practical measurement that can be made. The most accurate test is as follows; with a microscope count all of the scale on a card, noting any empty (pre-emerged) scale. Mark these numbers down in a log as well as on the actual card. Hang card in crop in the same manner as all the rest. After an appropriate time, (usually about 2 weeks), remove the card from the crop and count again. The number of empty scale at the end of the period, when subtracted by the empty scale at the beginning of the period equals the number of parasitiods that emerged in the crop. This test can become very accurate and powerful if the grower visits the card on a daily or regular basis. After a few days, emerged adults will be seen on the card. A gentle tapping of

the card will induce the wasps to fly. This becomes an immediate confirmation of flight capability and vigor of the wasps. A variation that can be used if predators or ants are present would be to contain the card in a bag or vial. Care must be taken to ensure that the scale is exposed to identical conditions as those in the crop and not exposed to direct sunlight. *ii*-loose scale: Large quantities should be visually inspected. A small amount of emergence confirms that the scale was not frozen or overheated. Smell is also a very important test. A smell of decay or rot will suggest that they may have been overheated or frozen and a more thorough test should be made. A simple emergence test would be to mix the scale, remove a small sample and place it in a "baggie" or small petri dish. The sample should be placed in the glasshouse with the crop in a protected area. After an appropriate period of time, usually about two weeks, the sample should be frozen, to make counting easier. A simple count of the emerged wasps and the total number of scale will give the grower an emergence percentage.

In summary, "Quality Control" testing at the grower level with each delivery is impractical. Instead, the grower should adopt a technique for "Quality Assurance" that will prove that the biologicals have survived the shipping and handling process and are present in the appropriate numbers. Production dates and quality statements from the producer will link the IOBC and ASTM Quality Standards to the growers' assessment.