

REPORT TO SARE

PROJECT # FNE99-256

1) GROWING CRANBERRY SPECIFIC PARASITOIDS FOR ON APPLICATION ON ORGANIC CRANBERRY BOGS. : I.E. how to grow indigenous *Trichogramma* wasps on the farm to control infestations of *Acrobasis vaccinii* (Cranberry Fruit Worm).

2)

As organic cranberry growers we rely on natural predators as a major means of pest control. Our most aggressive pest is cranberry fruitworm.(CFW) In its larval stage it is more destructive than any other cranberry pest. This moth lays its eggs in the calyx of the newly developing berry, immediately upon hatching the larvae enters the berry and develops inside of it. It destroys the berry and is itself fully protected, When it emerges it may eat its way through 3 to 8 more berries. Each moth lays about 50 eggs. Given that there are approximately 400 cranberries to the a pound, one CFW moth has the potential of destroying up to one pound of cranberries.

A major predator of the cranberry fruitworm is the *Trichogramma* wasp which lays its egg inside the fruitworm egg, destroying the larvae. A parasitized egg turns black and can thus be distinguished from a viable fruit worm egg which is green to orange. These differences can be easily seen with the aid of a magnifying glass.

Commercial insectaries sell *Trichogramma* wasp eggs for release among the crop, T. wasps are also effective for corn borers and have been developed extensively for this major crop. (see attachment # 1) For cranberries, which are a minor crop that relies heavily on chemicals, there has been no incentives (read funds) available, to do research designed to develop T. strains which specialize in cranberry fruitworm. However, commercial insectaries recommend various species of T. which are advertised as suitable for "orchard or field fruit" as also suitable for cranberries.. Over the years we have tried several of those species,(*T. evanescens*, *T. minutum*, *T. platneri*, and *T. pretiosum*) most often the choice was determined by availability. We were never quite certain if we had the appropriate parasitoid.

Because *Trichogramma* are polyphagous, meaning that they are not too fussy about what their larvae will eat, one can not be assured that they will destroy the pest we want them to concentrate on. Their release must be very close to where the pests are present. They do not have high searching ability, with their minute size they do not move over a large area, and while they have a short life span (8 days) and their populations grows rapidly during a single season, they need other hosts than CFW to overwinter since the CFW does not overwinter in an egg form.. Still the T. wasps are the only insect which parasitize the cranberry fruit worm egg. On conventional cranberry bogs the levels of parasitization are low, this finding is generally attributed to the use of insecticide sprays which destroy the predators along with the pests.

In our desire to find the specific T. species which would be effective for cranberry fruitworm, we came upon some disconcerting information:

The entomologist at the U.Mass Cranberry Experiment Station told us that when she ordered the recommended species of *Trichogramma* from commercial insectaries and released them in the lab, she found that *they showed no interest in the fruitworm eggs which were provided for them.* She wondered whether the nominally same species would only react to the host to which they had been conditioned, or if the species variability was greater than assumed. It looked like purchasing T. wasps eggs could be a waste of money.

Subsequently, we were told an even more discouraging story; an entomologist at a Mid Western university, wanting to test the reliability of the T. species identification, asked his graduate students to order some one specific species of *Trichogramma* from every advertised commercial insectary. According to an informal report, NONE of the wasps which arrived in the mail were found to be of the species on order. I learned later, as I will describe in another section, that this is not mere carelessness but the serious difficulty of keeping the multitude of variants of that species of the wasp, which is hardly visible with the naked eye, distinct and separate for propagation purposes..

Our common sense conclusion, which prompted this project, was that if we could collect parasitized eggs on our own bogs and rear the months in on-farm insectaries, we could then be assured of having a useful and functioning

* see communication as att: #8

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defense against our major pest. This was particularly enticing to us, as organic farmers, since we often found ourselves forced to develop our own methods and materials. *An immediate, and we now realize, somewhat superficial review of the literature, initial consultations, and some literature on raising insects for profit made this seem like a feasible project.* Currently, many growers do purchase *Trichogrammas* and place them on their fields. We hoped that with this project we could prevent them from wasting their moneys on an innappropriate species. In addition we had the goal of trying to encourage other cranberry growers to transition to organic methods and hoped to be able to provide a resource for dealing with one of the major pests.

Our conclusion was reinforced when our organic bog, along with several abandoned bogs, was used as a site for a study of "Parasitism of Cranberry Fruitworm by Indigenous *Trichogramma*", an undergraduate honors thesis at the Dept. of Environmental Studies at Brown University. (Rebecca C. Miller, 1996). Miller concluded that "if indigenous *Trichogramma* could be hatched in a lab from CFW eggs collected from local bogs and reared on another host to increase in numbers, releases of these *Trichogramma* might be more effective" than the usually low rates of parasitization found in the field. Lab reared *Trichogramma* which were closely related to indigenous *Trichogramma* would presumably have the gentic advantage of" the indigineous wasps' demonstrated ability to locate, identify and accept CFW eggs" Miller concluded that "selecting the appropriate species or strain of *Trichogramma* to use in a biological control plan is very important"

3)NA

4)Our two main cooperators were

Dr. Ann Averill, an entymologist at U.Mass. Amhers and the Cranberry Experiment Station, Dr. Averill was most helpful in showing us how to identify the eggs, collect the berries and intended to possibly provide parasitized eggs to us from the Experiment Stations' own bog IPM counts. She was cautiously optimistic about the possibility of rearing those wasps on the farm.

Dr. Richard McDonald, an entymologist, had worked for the State of North Carolina and at the time we initiated the project was about to open his own insectary in North Carolina. Dr. McDonald was most encouraging about the possibility of an amateur/farmer rearing these insects and promised to assist us in the developing of a rearing set up in a small greenhouse. He visited once and promised to return again to help us set up a small rearing facility we could use as a demonstration site for other growers. ✕

We also obtained a publication from Mayhill Press, Franklin, Tenn. entitled "Beneficial Insects How to Mass-Rear and Make a Profit" by Hilmur L. Saffell, with a chapter devoted to rearing *Trichogramma* wasps and detailed instructions for building a "Trichogramma Oviposition Unit" (attachment # 3)

5)

On Dr. McDonalds' suggstion we begun by constructing a small hoop house greenhouse, a portion of which would house the 'insectory', We then constructed the Oviposition Unit per directions.

Our time window for the project was fairly tight as the CFW moths begin to deposit their eggs as soon as berries look viable, preferring the larger topmost berries to ensure survival for their larvea., this is usually begins the first week in July. Several generations complete their flight by the beginning of August. The berries must be removed from the bog to be examined for the presence of CFW eggs, viable or paritised. For IPM purposes, to determine a need for insecticide application, it is recommended that 200 berries be removed, at random, per acre of bog. The presence of one viable CFW egg per acre triggers a spray. We began the collection of berries that first summer and had difficulty finding sufficient numbers of parasitized fruitworm eggs for rearing purposes. While we planned to contine this effort throughout the summer, it, however, was interrupted by an unique opportunity which presented itself.

p.2

* after initial enthusiasm in phone conversation
Dr. McDonald became less optimistic see Att # 8

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That June, a search of the Internet looking for any other *Trichogramma* research uncovered the fact that the *Midwest Institute for Biological Control* was offering a short summer course to be held at the *USDA-ARS European Biological Control Lab* in Montpellier, France. The course was open to graduate students in entomology and other biological control specialists, there was to be a special section on *Trichogramma* research and its augmentation, at the major laboratory specializing in *Trichogramma*, **BioTop** lab in Antibes. This course was underwritten by USDA and the only costs for the participants was airfare. After some correspondence with the coordinators, I was admitted to the course. The course took place July 18th to 25th and thus cut into that first year's field work. However, it was an excellent source of information and a great deal of hard work, before during and after the course, both in the classroom and in the field, combined with lectures from several US and European experts. At the end of this training it became very clear to me that the rearing of a specific T. wasp species, of any T. wasp for that matter, was much more difficult than I had been led to believe.. These are some of the practical barriers.

The Nature of *Trichogramma*: T.wasps are among the smallests of insects, their wingspread is about 1/50 of an inch. There are multiple species, difficult to distinguish and identify even in the most sophisticated of laboratories, and when identified, very difficult to keep separate. When purchased from a commercial insectary some 5,000 eggs are glued to a square inch of cardboard. This is how we have purchased them in the past, with very few accompanying instructions. We were not told by the commercial seller that this fragile wasp may not survive the trip if the temperature is high and it hatches prematurely. The wasps mate immediately upon hatching and need a food supply. They are nectar eaters and a bit of cotton dipped in diluted honey, creating very little dampness, or they will drawn, will help them to survive. Under the best of circumstances they only survive 4 -7 days in the field. Thus successive applications are recommended.

Only one wasp will hatch from the one parasitized egg, having purchased the eggs in a mass of thousands glued to an inch of cardboard, we had been under an erroneous impression that these wasps, like butterflies, lay clutches of eggs, and that a parasitized CFW egg will yield a number of T.wasps.

While we purchased them in sets of 5,000, and it is advised that one needs to purchase a minimum of 25,000 eggs per acre, thus searching for one's own indigenous wasps has very meager results. In other words, in order to collect a number of wasp eggs which could make sense of mass rearing one would have to remove tens of thousands of berries from the crop field, only a small proportion of which may carry the parasitized eggs. **Thus the problem of a single grower collecting enough wasp eggs from one small bog to actually rear large numbers of wasps is a major obstacle..**

I learned that the idea of rearing an indigenous species of *Trichogramma* had attracted other researchers over the years.. In the 1950's, Dr. Henry Franklin, the then Director of the Cranberry Experiment Station in Wareham, collected *Trichogramma* wasps off the Massachusetts bogs, sent them to California to be mass reared and released the returned wasps on the same bogs from which they were taken. The resulting parasitization did not increase from previous years.

According to Dr. Dan Mahr of U. of Wisconsin(as quoted in *Cranberries Magazine*, April 1999,) there have been many such experiments. Each time the results were disappointing, the natural level of parasitization was not exceeded significantly by the importation of wasps. Once we were made aware of the difficulty of rearing and propagating the wasps, we realized that it is anyone's guess whether the rearing situation could be trusted to return an accurate sample. In addition some researchers have suggested that given the non-specific nature of the potential hosts of T. wasps, there may have to be a minimum density of host eggs before a significant level of parasitization is achieved, that is, if it is too early in the season for a large number of CFW eggs to be present on the bog, the wasp will choose another host. (p.3)

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All this illustrates the difficulty of dealing with such a small and fragile organism and attempting to make it perform to expectations.

Additional confusion comes from the difficulty, mentioned before, of identifying the specific species of *Trichogramma*. In reviewing the available information we have come upon many conflicting identities. We have also come across many different conclusions from researchers over the years as to the particular species of *Trichogramma* which parasitizes a particular pest.. In fact just how specialized the *Trichogramma* are is also in question, they may parasitize a broad spectrum of insects, and may have preferences for hosts of which we are not aware.. *Trichogramma* mate and lay eggs almost immediately upon hatching so the about to hatch eggs must be placed very close to their target pests. Wind, rain, extremely warm temperatures or a sudden chill will all interfere with their reproduction.

At BioTop, after many years of research, a method of dispersion was developed for use of T. wasps against the European Corn Borer. Considering the short life of *Trichogramma*, the fact that it does not disperse over a large distance and is itself vulnerable to predators, placing the hatching *Trichogramma* as close as possible to the site of the host eggs and the crop to be protected, is very important. The researchers working with corn crops have tried everything from dispersing the egg covered squares from airplanes to attaching each one to a single corn stalk.. Finally, small capsules made of biodegradable material were used with the T. wasp eggs placed inside, these were uniformly scattered over the corn rows and their degradation timed to coincide with the development of the T.wasp. An additional refinement was distributing different color capsules with T.wasps at different stages of development so that a continual hatch could be assured. (attachment # 2)

5,6) Finally, accepting the fact that we would not be able to mass rear *Trichogramma* wasps, in spite of the commercial hype to that effect, we decided to attempt to obtain some more information about the indigenous wasps without having to remove many pounds of saleable berries from our bogs in our search for parasitized CFW eggs. We, therefore, compared a small sample of our berries, grown on an organic bog, as well as berries from two other small organic bogs, with a several samples, (300 berries avg.) collected by conventional growers as part of the IPM program, and also with berries which we collected from wild, overgrown bogs. We consistently found a larger number of parasitized eggs on the cultivated organic bogs. We concluded that applications of pesticides on conventional bogs reduce the population of parasitoids, but also that the habitat of an overgrown bog may not be as hospitable to *Trichogramma* for two reasons, one- that given the larger variety of weed and other plants which invade a non-managed bog, there may be an abundance of other possible hosts, insects inhabiting the weeds in greater abundance than the eggs of CFW, secondly the excessive moisture which tends to characterize abandoned bogs, with their clogged drainage, may be detrimental to this delicate wasp. . **We learned that it was important to understand the requirements for an optimum habitat for the parasitic wasps, in order to encourage their presence on the bog.**

7) NA

8) NA

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9)

Given our experience in attempting to understand the rearing of T.wasp we can now state the following:

- a. There are indigenous T. wasps on cranberry bogs of a specific species which
- b. exert some measure of control over the fruitworm pest .
- c. the difficulty of identifying and rearing these wasps has been found to be require such specific knowledge and facilities that it has taken years of research for the best trained and equipped scientists.
- d. we recommend that growers learn more about these natural predators that live on their bogs and encourage and support their **natural** increase in the following ways:
 - i. adult T. wasps feed on **nectar** , the bog should be provided with some areas of nectar bearing plants so as to provide an enviroment where the wasps can feed and live. If the bog covers large acreage, some small areas of flowering plants can be interspersed throughout, either on the dikes or along the ditches.
 - ii. These wasps are very delicate,we recommend **providing shade areas, avoiding sprays** whether chemical or not, during the short time when these predators are available,
 - iii. and monitoring the populations of cranberry fruitworm through the use of pheromone traps, so as to understand when the host eggs are most available and the T. wasps most likely to be present.

There has been additional research since we begun this study(attachment #4) It provides a possible solution but also demonstrates the scientific difficulties:

with the increasing interest in natural controls and increasing numbers of organic cranberry growers, this research has been initiated in Canada. Researchers at **Insecterra Inc.** in Montreal, Canada have conducted two years of field tries with indigenous *Trichogramma* collected in wild cranberry bogs. . The strains were rated for efficiency and for ease of rearing. A satisfactory strain was isolated and currently tests are underway to see if that strain will be effective in different locations. One of the issues with native parasatoids is that they will not persist in area unless there are pests there for them to parasitize. Thus a successful reduction of the pests will also reduce the population of the control . A grower must have the patience, or teh economic viability, to go through the cycles of increased infestation followed by control.

10) We plan to continue to rely to some extent on the natural controls provided by T. wasps.

Firstly ,we hope to purchase some from Insecterra Inc. when they become commercially available.

Secondly,we were also told by the researchers there that there is apossibility that we could again try to collect a small smaple of parasitized eggs from our own bogs and ship them to that lab for rearing.

Insectarra Inc. does not yet know if the strain they have isolated will be eqully effective in various locations.

In spite of the material we are including here on how to rear these insects ourselves, (attachment # 5) after observing such installations in professional labs, we do not believe that it is possible for a farmer to be sucessful at this endeavor. Visiting the *BioTop* lab, I realized that just keeping the tiny wasps confined was an almost impossible task. We will however, concentrate on developing a habitat for this predator. We have placed small beds of lavender, fennell and oregano around the bogs for maximum nectar production. These plants are easy to cultivate and useful for our kitchen use. We have also planted small beds with late flowering plants so as to keep the T. wasps in the bog area and hopefully encourage them to overwinter there.

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11) We discussed this project at a meeting for organic growers which we held in November of 1999 and again in 2000, at the Cranberry Experiment Station in Wareham, Ma. During that time we also produced a newsletter for growers who were interested in transitioning to organic management

. In the July/Aug. newsletter management of T.wasps was discussed (attachment # 6 p.4)
In 2001 the third session of the organic conference was held, this time it was coordinated by the Cranberry Experiment Station, , acknowledging in the introduction our initiation of the first two meeting. The Proceedings of this third conference were subsequently published (attachment # 7)

And finally, as members of Northeast Organic Farmer's Association and as consultants to local growers we have been able to provide information to other growers both in workshops at NOFA conferences and meetings , and in informal discussions.

Kristine R. Keese

Feb.1, 2003

FA # 8

From: Cahow McDonald <the_edge@appstate.campuscwix.net>
To: rkkeese <cranhill@capecod.net>; sminick@juno.com <sminick@juno.com>;
jminick@runet.edu <jminick@runet.edu>
Date: Monday, May 03, 1999 10:21 AM
Subject: Re: Trichogrammas taking over

Kristine,

Congrats on going to France for parasitoid/Trichogramma work! I would like to tell you what I know about Trichogramma rearing - as I understand it, it is very technical, and something that I think we might be able to do further down the line. My initial thought would be to raise a generalist predator along the line of the Minute Pirate Bug or some similar insect that we find in your bogs, for mass rearing and release. We need to crawl before we walk, and walk before we run, if you know what I mean. More on that later.

First off, Dr. David Orr at North Carolina State University, Department of Entomology, just completed an extensive review of all suppliers of Trichogramma in the United States. He had someone order Trichogramma for him, and then he analyzed each order as it came in, to determine if the wasps were healthy (alive), and if they were the correct species. As I understand it from him, he found that NONE of the USA suppliers had the correct species that they advertised, and that several companies sent orders in which the wasps had already emerged - so there were NO wasps alive upon receipt!! He will be publishing the results of his study soon, and it should cause some major ripples in the beneficial insect supplier's circles. You might want to email/call him about this. His contact numbers:

Dr. David Orr
Department of Entomology
North Carolina State University
Box 7613
2301 Gardner Hall
Raleigh, NC 27695-7613
email: david_orr@ncsu.edu

Dr. Orr has contacts with a French Company called Biotop (pronounced Bio-tope). They specialize in rearing Trichogramma and all reports are that they are excellent. If you are going to France, by all means, if possible, you should visit with them. The contact I have for them through Dr. Orr is:

Firouz Kabiri
Biotop
D4 Route De Biot f-06560 Valbonne

5/3/99

Att. 3

"Bacterial Insects: How to Mass-Rear & Make a Profit"
H.L. Saffell, Mayhill Press, Tenn

Trichogramma Oviposition Unit:

All measurements are in inches.

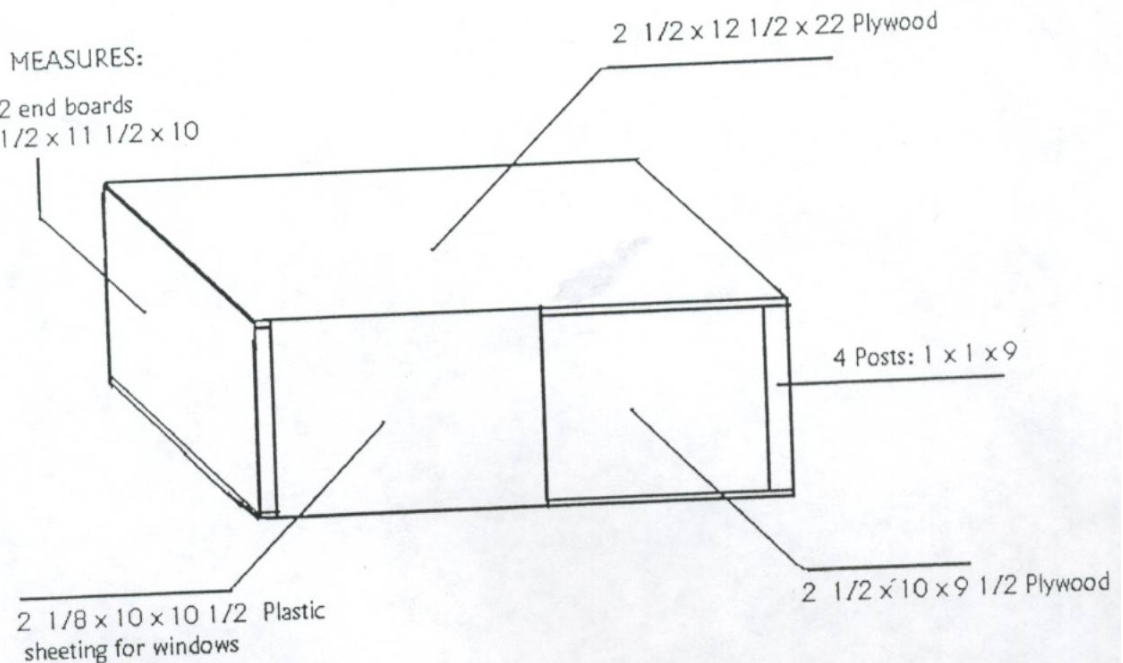
Main supplies needed:

- 4 posts 1 x 1 x 9
- 24 plastic trays 5 x 10 x 1/8
- With plastic noseguards 1/8 x 1/2 x 5
- 6 masonite boards 1/8 x 12 x 20 1/2
- 2 plywood boards 1/2 x 12 1/2 x 22
- 2 plywood boards 1/2 x 9 1/2 x 10
- 2 Plywood boards 1/2 x 11 1/2 x 10
- 4 strap type hinges
- 4 "L" turn type latches
- 2 plastic sheets 1/8 x 10 1/2 x 10
- 4 strap type hinges
- 4 "L" turn type latches
- OR POST.

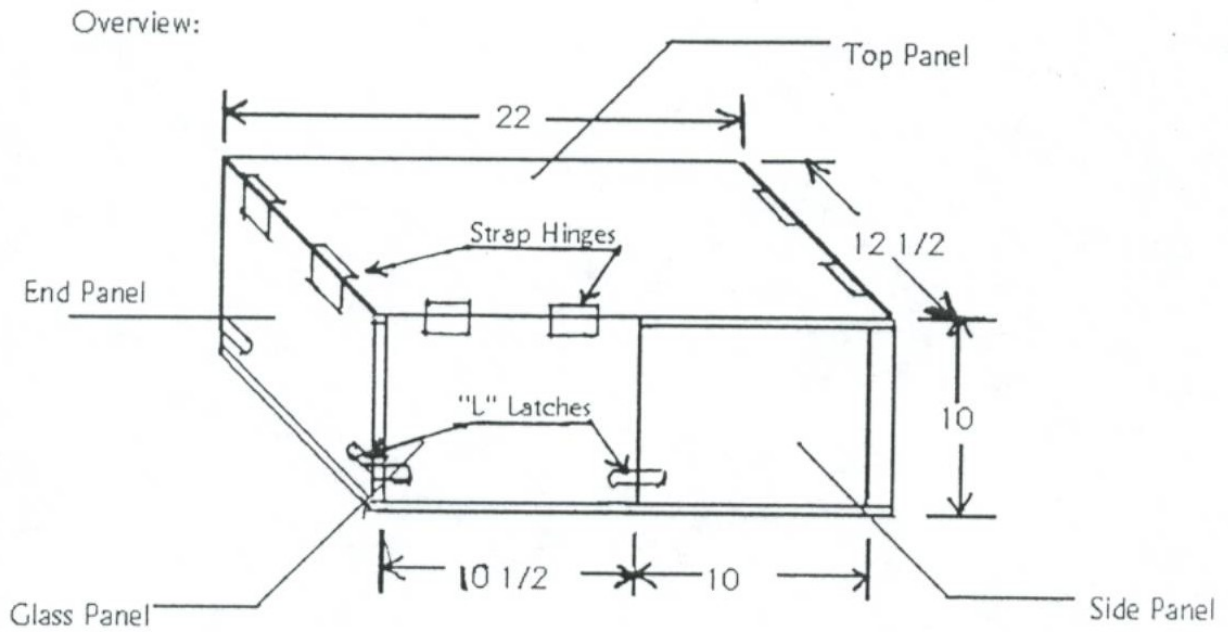
Assorted nails, brads, fasteners and power tools for grouting, etc.

Setup for two 40 watt light bulbs - 1 for each plastic "window" - set 6-10 inches outward from plastic windows.

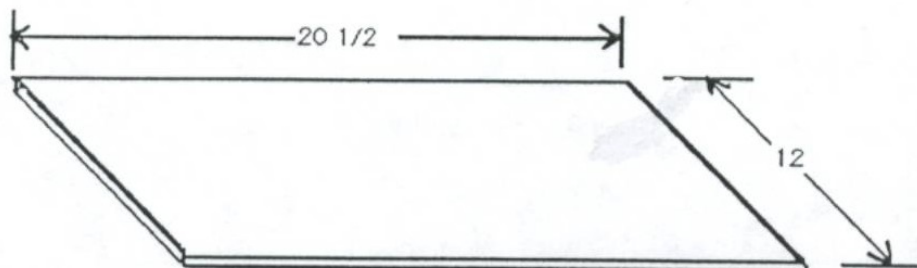
NOTE: DO NOT ANCHOR IN GROUTING IN SIDE BOARD OR POST.



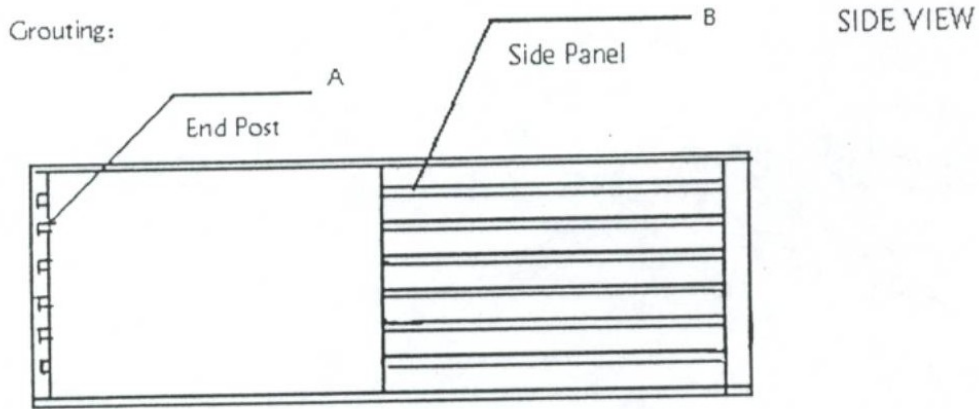
Trichogramma Oviposition Unit:



Masonite Shelving:



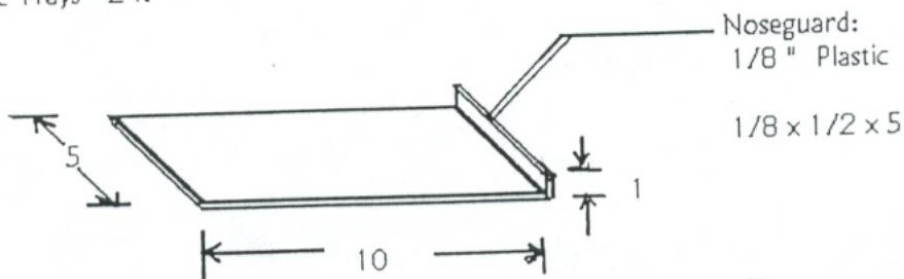
Trichogramma Oviposition Unit:



A: Grouting 1/4 " deep on two inside edges. Left two posts only.

B: Grouting 1/4" deep on inside side panels. At 1 1/2" intervals from bottom board.

Plastic Trays - 24:



Thin laminated cards (5 x 10 inches) are equal to 50 "Squares" or 50 square inches. Each 1 inch square can hold anywhere from 3,000 to 5,000 eggs which have been "seeded" with wasp eggs. You can also use paper strips which have been waterproofed. Both of these can be affixed to the plastic trays. If you want bulk eggs (which many growers raise), you can just "dust" the moth eggs onto the plastic sheets. In any case, wet down the plates or strips first so the moth eggs will adhere to them. When you have finished, your plates will look like rough sandpaper.