Sustainable Pest Management Lab
University of Hawaii at Manoa

DIY Screenhouse for Insect Management in the Tropics: Part I

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INTRODUCTION

Due to growing environmental consciousness among consumers and growers, organic farming approaches are gaining popularity amongst vegetable farmers. However, organic farmers in Hawaii are concerned about the lack of effective, organic insect pest management tools (Radovich, 2009). Constructing screenhouses with insect exclusion nets for crop production has been practiced elsewhere and proven to reduce pesticide applications and increase crop yields compared to open field production (Romeo-Gámez et al., 2011). Purchasing fabricated screenhouses is extremely costly for farmers in Hawaii as it involves expensive shipping costs. Sugano et al. (2014) had developed protocols to construct affordable screenhouses using home improvement store supplies (http://www.ctahr.hawaii.edu/WangKH/Downloads/P-DIY-screenhouse.pdf). Costs can be reduced for farmers if materials are procured from local hardware stores. Screening material can be sewn with UV resistant thread to meet the appropriate dimensions of the screenhouse. There is a reduced cost to farmers with materials from home improvement stores and screen material that can be sewn with UV resistant thread to get the desired width. Strong gusty winds during certain times of the year create a challenge for these structures to hold their shape and stay in place. This article modifies screenhouse designs from Sugano's et al. (2014) publication to improve performance.

Unlike some of our U.S. mainland counter parts that had been using screenhouses or hoop houses to extend the crop-growing season into the winter, the main objective of the CTAHR screenhouse designs is for managing insect pests that are difficult to be managed with insecticides. Some pest examples include, pickle worm and melon fly on cucurbit crops, imported cabbage worm or other Lepidopteran pests on cabbage or other brassica crops, flea beetle on eggplant, rose beetle on strawberry, taro and many other crops. We used 17-mesh screen material that excludes larger size insect pests like listed above but not smaller soft body insects such as aphids, whiteflies, and thrips. Although mesh size can be substituted for a 60 mesh to exclude smaller insects, ventilation in the house will be significantly decreased and heat related stress can increase.

Western Sustainable and Agriculture Research and Education Professional and Producer (WSARE P&P) program and the CTAHR Supplemental Fund funded a 2-year project for our team to develop and promote the use of screenhouses for small-scale vegetable crop producers. This report summarizes what we have developed in collaboration with three groups of participating farmers.

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DESIGN 1: SCREENHOUSE WITH WOOD-BASE FRAME (dimension: 15’ × 50’ × 6’)


Materials and Supplies

Materials/Supplies	Quantity
Insect netting (24' × 66')	$ 137.28
V-69 White Polyester UV Thread	1
¾” gold “T” Fitting (FT) EZ Corners	10
¾” gold Slide Thru “L” (FOL) EZ Corners	4
¾” gold “T”	4
5/8” × 20’ rebar (to be cut in thirds)	5
¾” × 10’ EMT conduit (for ribs structure)	28
250' plastic coated 12 gauge electrical wire	1
¾” set screw coupling	3 (1 bag)
2" × 4” × 8’ lumber (includes 2” × 4” to construct door)	31
Simpson plate joiners (to secure butt to butt 2” × 4” lumber)	30
½” galvanized pipe straps (to secure 2” × 4” lumber to EMT conduit)	36
1” × 2” × 8’ strip lumber (includes 1” × 2” for door)	24
1” × 4” × 8’ lumber	6
Simpson Strong Tie Heavy Angle	4
1” galvanized pipe straps (to secure door frame to T-post)	4
½” pipe insulation (for sealing space between door and door frame)	1
4” galvanized door hinge	2
galvanized door pull handles (inside and outside)	2
8’ T-posts (to anchor door frame to screen structure)	2
4” galvanized barrel latch (for door)	1
½” self-tapping screws	1 box
1 ½” deck screws (1 pound screws)	1 box

Estimated Cost:

Insect netting (24' × 66') @ $208/200 ft.	$ 137
Supplies for wooden door	$ 86
Supplies for wooden frame structure	$ 490
Total	$713
Price per sq. ft.	$0.95

Price does not include labor or taxes.

DESIGN 1: SCREENHOUSE WITH WOOD-BASE FRAME (continued)

Procedures

Before going to job site:

1. Cut the 20 ft. 5/8" diameter rebar into thirds (6' 8" each piece).
2. Cut fourteen 10 ft. 3/4" conduit into 7' 6" lengths (need 14 of these for the ribs).
3. Bend 14 of the 7' 6" long conduit in an “L” shape for the top ribs of the frame.
4. Cut fourteen 10 ft. 3/4" conduit into 7' 5" lengths (need 6 of these on each side to secure spacing of the ribs and 2 connecting the top rib in middle, one in the front of the screenhouse and one in the back).
5. Construct door and door jamb (6' tall by 32" wide).
6. Attach door to jamb with hinges, also attach door pull, barrel latch and screen onto door.
7. Sew screen material to desired width using V-69 White Polyester UV thread.

At job site:

1. Best to orient screenhouse north to south, measure out area to be covered.
2. Install rebar at 7' 6" on center spacing (7 on each side).
3. Build the bottom frame flush to the ground with 2” × 4” lumber. Connect lumber with Simpson plate joiners.
4. Secure the bottom frame to each rebar using pipe straps.
5. Insert and secure slide thru "T" and "L" (from E-Z Corner) to bent end of conduit.
6. Insert top end of rebar into bent end of conduit that has the slide thru "T" & "L"

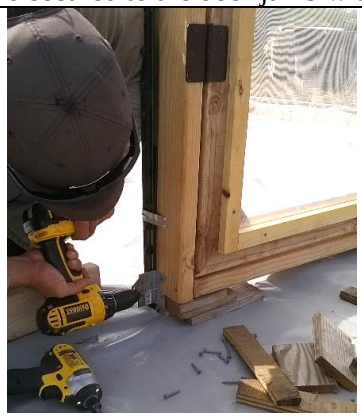
   (bent conduit with the slide thru "L" are for the 4 corners).
7. Insert the 7' 5" length conduit into the slide thru "T" & "L" (parallel to ground, this will secure spacing between ribs).
8. Connect the straight end of adjacent conduits with conduit connectors (this completes each rib).
9. Install door; it is anchored with 2 T-posts pounded into the ground and secured to the door jamb with several pipe straps.
10. Run plastic coated #12 gauge stranded electrical wire on both sides of the structure just above the bend on the conduit (the wire runs lengthwise, conduit to conduit, to help hold up the insect exclusion screen between ribs). Secure with ½” self-tapping screws just below wire on each conduit.
11. Cover entire frame with insect exclusion screen.
12. Staple edges of insect exclusion screen to bottom frame.
13. Staple screen around door jamb and cut screen so door can be opened.
14. Nail 1” × 2” lumber over all spots with staples (including around door and door jamb).
15. Cut off excess screen material (best using sharp utility knife).

DESIGN 1: SCREENHOUSE WITH WOOD-BASE FRAME (continued)

Install rebar at 7’6” spacing, connect bent end of conduit to rebar, join the conduits with the "T" or "L" slide thru EZ Corners ("L" are for the 4 corners). Install top center conduit in front and back of structure.

Build the bottom frame with 2”×4” lumber and Simpson’s joint plates and secure the bottom frame to each rebar using pipe straps.

Erect a door anchored with 2 T-posts pounded into the ground and secured to the door jamb with pipe straps.



Door is installed and attached to T-posts using 1” pipe straps. Secure door to the rest of the frame with

Simpson Strong Tie Heavy Angle.

Run plastic coated #12 gauge electrical wire on both sides of the structure just above the bend on the conduit.

Cover entire frame with insect exclusion screen, pre-sewn to a width of 24'. Staple edges of insect exclusion screen to bottom frame. Nail 1" × 2" lumber over all stapled areas. Cut out excess screen material. Fold up excess screen on the corner, secure with pipe strap.

One drawback of growing crops inside a screenhouse compared to growing crops in an open field is that pollination may be compromised which is a problem for cross pollinated crops. In addition, natural enemies such as parasitic wasps, lady beetles, hoverflies, lacewings, dragonflies etc. will also be excluded, creating potential for pest outbreaks of smaller insects (soft body insects). Thus, a new screenhouse design with a retractable screen wall was constructed to examine the potential benefits of allowing the movement of these beneficial insect predators (beneficials) into the screenhouse production area.

DESIGN 2: SCREENHOUSE WITH RETRACTABLE SCREEN (dimension: 15' × 50' × 6')

Procedures for adding in the retractable wall

1. Build wooden base and frame of the structure same as design 1.
2. Make an additional frame base for the retractable side of the screenhouse (this will provide more support for the retractable wall).
3. Before putting the screening material over the structure, secure 1" × 4" × 8' lumber for the top of the retractable wall to the outside of the conduits along one side of the structure with deck screws.
4. Secure the screening material over the lumber from step 2.

5. Connect conduits on the bottom of the retractable wall with conduit connectors & self-tapping screws.
6. Wrap bottom of screening material with snap clamps.
7. Drill holes in the wooden frame to place eye screws to run the billow cord through. Inside the screenhouse make pilot holes and install eye screws on top of bottom frame and beneath top frame. Outside the screenhouse make pilot holes and install eye screws alternating with the inside and placed facing outward on both top and bottom pieces of the frame
8. Make pilot holes on the top and bottom lumber facing outside for eye screws to run a cord through to create a pulley system (number of pulley lines is dependent on the length of the structure).
9. Loop cord around the bottom bar of the retractable wall pulley system.

Materials and Supplies (Screenhouse with Retractable Wall)

Materials/Supplies	Quantity
Insect netting (24' × 66')	137.28
V-69 White Polyester UV Thread	1
¾" gold slide thru "T" (FT) EZ Corners	10
¾" gold slide thru "L" (FOL) EZ Corners	4
¾" gold "T" EZ Corners	4
5/8" × 20' rebar (to be cut in thirds)	5
¾" × 10' EMT conduit (for ribs structure) bended	14
250' plastic coated 12 gauge electrical wire	1
¾" × 10' EMT conduit (for spacers between ribs)	14
¾" set screw coupling	3 (1 bag)
Simpson plate joiners (to secure butt to butt 2" × 4" lumber)	30
½" self-tapping screws	1
2" × 4" × 8' lumber (includes 2" X 4" to construct door)	31
Simpson Strong Tie Heavy Angle (to secure 2" × 4" to door frame)	4
1" × 2" × 8' strip lumber (includes 1" × 2" for door)	24
½" galvanized pipe straps (to secure 2" X 4" lumber to EMT conduit)	36
1" galvanized pipe straps (to secure door frame to T-post)	4
½" pipe insulation (for sealing space between door and door frame)	1
4" galvanized door hinge	2
galvanized door pull handles (inside and outside)	2
8' T-posts (to anchor door frame to screen structure)	2
4" galvanized barrel latch (for door)	1
1 ½" deck screws (1 pound screws)	1 box
¾" × 10' EMT conduit (for bottom of open side)	5
1" × 4" × 8' lumber	13
½" eye screws (to secure zig-zag billow twine in an outside of screen house)	60 (2 boxes)
¼" nylon rope (for billow control)	200'
small washers (may use to secure screen to EMT conduit)	50 (2 boxes)
snap clamps	30 (3 packs of 10)

Estimated Cost:

Insect netting (24' × 66') @ $208/200 ft.	$137
Supplies for door	$ 86
Supplies for structure	$490
Supplies for retractable wall	$107
Total	$820
Price per sq. ft.	1.09

Price does not include labor or taxes.

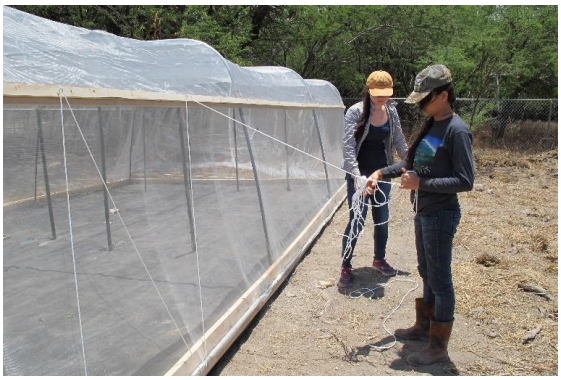
Procedures for adding in the retractable wall (continued)

A time-lapsed video of the screenhouse construction is available at https://youtu.be/cBP52egYG9s.

Securing the frame for the top of the retractable wall.

Connecting conduit for the bottom of the retractable wall.

Secure screen of the retracting wall to the conduit, put eye screws on upper and lower wall panel for billow twine.



Thread one billow twine through the eye screws outside and one inside of the retractable screen.

Lift up the retractable screen with four pulley ropes. Pound in trellis poles and get ready for planting.

DESIGN 3. Hoop house

Materials and Supplies

Materials/Supplies	Quantity
Insect netting (24 × 53 sq. ft.)	1,272 ft^2
V-69 White Polyester UV Thread	1
½" rebar, 4' long	18
¾" EMT conduit, 10' long	10
¾" schedule 80 PVC pipe, 20' long	9
weed mat staples	25 (2 packs)
½" self-tapping screws	44
3/8" aluminum pop rivets ½" depth	34
Zip-ties	1 pack
Deck screws	1 box
pre-made door, 6" tall	1

A time-lapsed video on hoop house construction is available at https://vimeo.com/166306088.

Estimated Cost:

Insect netting (24' × 66') @ $208/200 ft.	$110
Supplies for door	$86
Supplies for structure	$184
Total	$380
Price per sq. ft.	$0.68

Price does not include labor or taxes.

Procedures

1. Install ½" rebar at the desired interval.
2. Put PVC on one rebar, bend to form a "hoop" shape and place it on the opposite side rebar.
3. Flatten ends and middle of the conduits and rivet to the PVC for the structural support of the sides and the top.
4. Connect the conduit to the PVC using 3/8" aluminum pop rivets.
5. Install door; pound 2 T-posts into the ground and secured to the door jamb with several pipe straps and deck screws.
6. Adjust the height of the house accordingly by moving the PVC pipe up or down on the rebar and use the ½" self-tapping screws to keep the PVC pipe at the desired height.

7. Cover frame with insect exclusion net, use weed mat staples to hold net in place and bury the edges with soil.

8. Staple netting to door frame, for a clean finish, nail 1” × 2” lumber over all spots with staples, and cut excess screen.

Hoop house structure with rebar and PVC pipes. Spacing conduits on the side provide structural support. Bottom of the screen is then buried with soil.

References Cited

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