Sustainable Pest Management Lab

Wasps Nesting Block: A condominium to attract Natural Enemies of Insect Pests

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As the honey bee colony collapse syndromes are becoming a concern, some begin to look for approaches to attract alternative pollinators to pollinator-dependent cropping system. Building nesting blocks for leaf cutter bee (*Megachile* spp.), carpenter bees (*Xylocopa* spp.), and several other solitary bees have been promoted (Greer, 1999) to attract these pollinators. Interestingly many of these solitary bees' nesting devises are often solicited by solitary wasps. From an integrated pest management perspective, these bee nesting blocks (some time known as leaf cutter bee box) intermittently could serve as a device to attract natural enemies to our agroecosystem. One group of natural enemies of interest is predatory wasps. This article focuses on describing how to facilitate the use of a wasps nesting block in a hydroponic or aquaponic cropping system for insect pest management through conservative biological control approach.

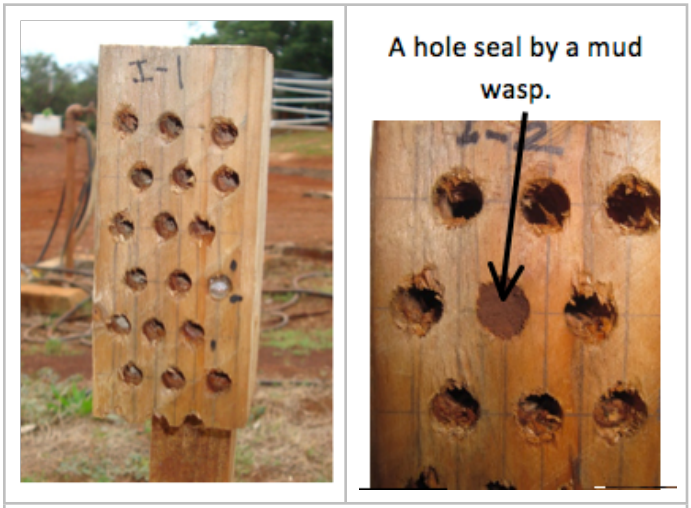

Fig. 1. Wasps nesting block.

Role of wasps as natural enemies:

Conservative biological control is a stewardship of existing natural enemies of pests by providing good habitat for the natural enemies. Predatory wasps play an important role in conservative biological control against arthropod pests in agroecosystems (Martin et al., 2013). There are two types of predatory wasps: social and solitary. Social wasps build large nests and live in a group. They tend to be more aggressive, and will be very protective of their nest. On the other hand, solitary wasps do not live with multiple individuals in a single nest, and are non-aggressive unless you accidently step on one (Raupp et al., 2013). Thus, they are friendly to work with. Most solitary wasps are generalists, which mean that they will prey on spiders, beetle larva, and caterpillars for their young, while adults commonly feed on nectar (Raupp et al., 2013, Evans, 1966). An example of a beneficial predatory wasp commonly found in Hawaii is the keyhole wasp (*Pachodynerus nasidens*). This solitary wasp preys on caterpillars (Carpenter, 2008). The keyhole wasp is capable of nesting in a variety of locations including abandoned nests of other wasps or insects, spaces between wood siding of houses, and other small holes (Carpenter, 2008), which make them a potential resident of the wasp nesting block.

Although this is a solitary wasp, the keyhole wasp does not mind living in close proximity with other solitary wasps and bees such as a niche provided by a wasps nesting block.

Another predatory wasp commonly found in agroecosystem in Hawaii is aphid collecting wasps (*Passaloecus* sp.).This wasp is much miniature in size than keyhole wasps. As its name implies, aphid collecting wasps mainly feed on aphids. The female collect aphids and stash them in a nesting hole after laying their young (Corbet and Backhouse, 1975).

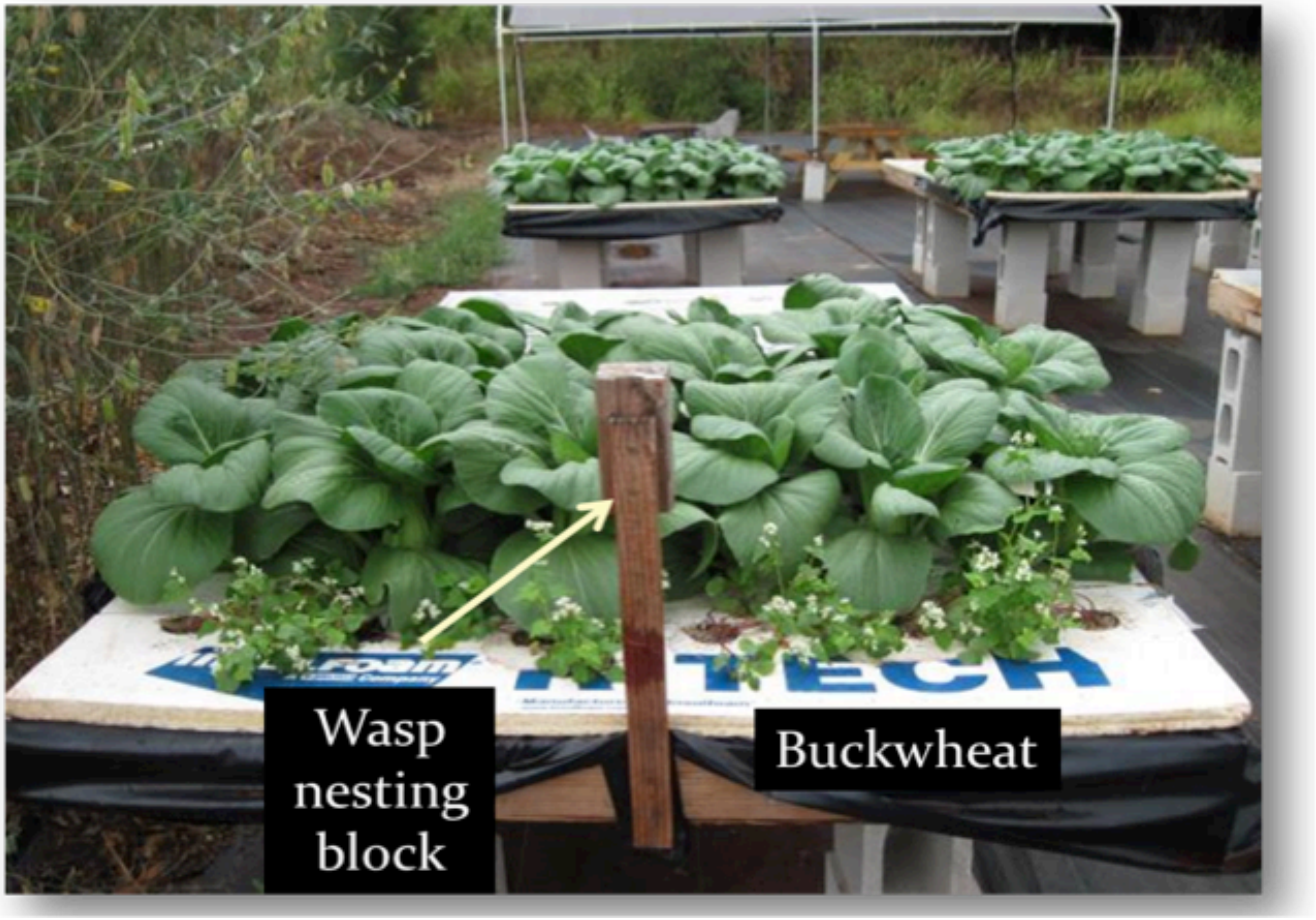

Fig. 2. Mounting of a wasp nesting block to a pak choi hydroponic box along with buckwheat insectary plants and sunn hemp border crop to attract various natural enemies of caterpillar pests of Pak Choi.

Construction of Wasp Nesting Block

For detail instructions on how to build a wasp nesting block, please refer to the website of Fritz Haeg Studio (last accessed on September, 2013). The size of the individual drilled holes varies based on the target insect attractants. Fritz Haeg Studio recommended ¼" (0.63-cm) diameter and 2" (5-cm) deep for leaf cutter bees; and ½" diameter and 5" deep for orchard mason bees. Fig. 1. shows a wasps nesting block made from untreated, recycled wood pellet drilled with 3/8" (0.95-cm) diameter and 2" (5-cm) deep holes. Spacing between holes are approximately 0.5-cm. The block is measured 6 × 6 × 14-cm3 in size. This wasp nesting block is then

mounted to a piece of stick and nail to the edge of a hydroponic or aquaponic box such as that shown in Fig. 2.

Insectary settings using wasps nesting block

To further facilitate the function of this wasps nesting block as part of a conservative biological control, insectary plants are planted in close proximity to the block so as to provide pollen and nectar sources for the occupants using the wasps nesting blocks. For example, buckwheat (*Fagopyrum esculentum*) is planted in and sunn hemp (*Crotalaria juncea*) is planted next to a pak choi (*Brassica rapa chinensis*) hydroponic box (Fig. 2).

For more information about insectary plants in Hawaii, please visit http://www.ctahr.hawaii.edu/WangKH/insectary.html.

Occupants of wasps nesting block:

Four wasps nesting blocks were set up by a green onion hydroponic box between 7 Feb and 18 April 2013 at the Poamoho Experiment Station, University of Hawaii. Insect occupants of wasps nesting blocks were observed and monitored weekly. Among the most commonly found insect occupants are keyhole wasp (*Pachodynerus nasidens*) which is one type of mud wasps, and the yellow faced bee (*Hylaeus* sp.) (Fig. 3).

Fig. 3.(A) A keyhole wasp visiting a wasps nesting block, (B) keyhole wasps seal the holes with mud after eggs are laid inside the holes, when their youngs are ready to emerge, they open a hole through the mud pad, (C) a mud wasp nest that was attacked by ants, noted by the pinhole entry hole made by the ants.

After the keyhole wasp lays her eggs inside a hole in the wasps nesting block (Fig. 3a), she will gather mud to patch up the hole (Fig. 3 b). When keyhole wasps' siblings are ready to emerge from the mud covered hole, they will open a hole through the mud patch. Ants can be a problem if they come to the nest as they will dismantle the developing larva inside and carry it off to their own nests (Fig. 3 C). However, this is an easy problem to fix with the use of Tanglefoot (The Tanglefoot Company, Grand Rapids, MI) painted around the base of the stick that attaches the block to the hydroponic bed. Hylaeus bees or yellow face bees occasionally were seen using the nesting blocks. However, they build different looking nests for their young. After

laying eggs into a hole in the wasps nesting block, the Hylaeus bee constructs a clear cellophane membrane to cover the hole (Fig. 4a).

Fig. 4 (A) A hole on wasps nesting block sealed by a Hylaeus bee after she laid eggs, her young recently emerged and broke through the seal membrane, (B) aphid collecting wasp is frequent visitor of buckwheat flowers planted in a hydroponic insectary setting box.

Aphid collecting wasp (Fig. 4 b) is another frequent visitor of the insectary setting treatment in our hydroponic box mostly attending the pollen and nectar provided by buckwheat insectary plants. Although we did not find holes occupied by aphid collecting wasps in our wasps nesting block in this experimental site, they are another potential insect that will use this block. Nest covering built by aphid collecting wasps is generally white but the color of the covering can vary based on the resin used by the wasp (Bees, Wasps, and Ants Recording Society, 2002).

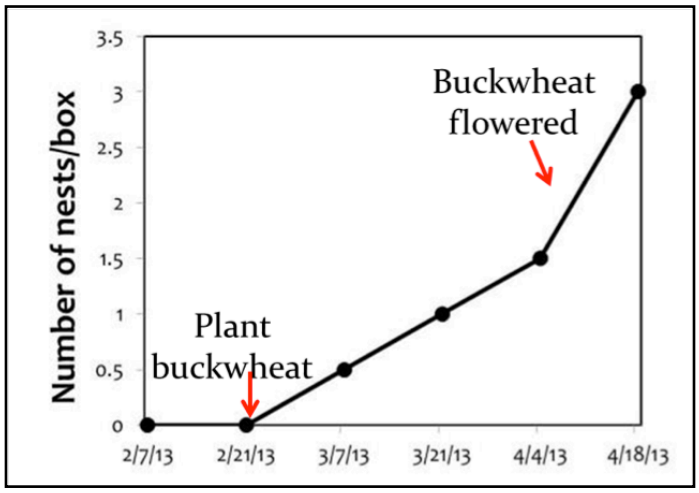

Fig. 5. Number of holes in a wasps nesting block occupied by keyhole wasps.

The number of holes on wasps nesting blocks that are occupied by wasps or bees increased slowly after the initial establishment of insectary plants and wasps nesting block. However, a sharper increase of the occupancy was observed soon after the blooming of buckwheat (Fig. 5). This suggests the benefits of integrating blooming insectary plants with the use of wasps nesting block for attracting beneficial insects to our targeted agroecosystem.

Performance of wasps nesting block would strongly depend on the wasp species pre-

sent in an agroecosystem. It is possible to move wasps residing in the nesting block from one area to another, but it is important to ensure that the new environment provides food source such as nectar, pollen, or insect prey for the predatory wasps. Agroecosystem that might be able to take advantage of introducing wasps nesting block include but not limited to monoculture cropping system that are free of flowering weed borders, high tunnel screen house that block out entrance of predatory wasps, crop production that focus on vegetative growth such as production of tea, basil and green onion etc.

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