Evaluation of different application methods of Q-Pest in controlling Erythrina gall wasp (刺桐癭蜂) Infestation in Erythrina variegate(刺桐)

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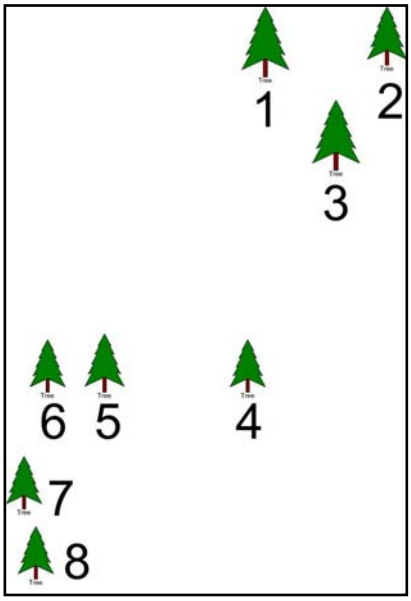
Infestation of Erythrina gall wasp (EGW) has been reported in several countries, including Singapore, Taiwan, and Hawaii (USA). Erythrina Gall Wasp (EGW) is very minute insect, about 1mm in length. EGW has been stinging Erythrina trees used in landscaping, causing galling of the leaves, stem, flowers and seedpods. The emerging new growth are usually stung by these wasps making them unable to form healthy leaves for photosynthesis and flowers to produce seeds for the next generation of these species. The wasp stings and lays its eggs inside the tissue making the tissue swell up which is called galling. The larvae feed and mature inside the tissues and emerge from the punctured holes visible on the leaves or the infected parts of the tree.

Chemical method to control EGW problem had been studied in Hawaii by University Of Hawaii at Manoa. In their study, application of systemic insecticide -- imidacloprid (the active ingredient of “Q-Pest”) to infected trees showed positive result after 1 to 4 months depending on the application methods (soil drenches vs tree trunk injection).

Since the situation in Hong Kong is different from Hawaii, soil drenching method can be applied in different ways. In Hong Kong, imidacloprid is sold and available as “Q-Pest” which is packed in water soluble bags (10g/bag). The usual method of soil drenches is to apply diluted insecticides around the base of tree trunk, similar to irrigation. The advantage of water soluble packaging is that imidacloprid can be put into the holes dug in the soil, and slowly released over time upon irrigation.

Testing Site: Tai Hang Tung Estate Playground 2



Trees location inside the playground and numbered as above diagram

The infected branches of trees were trimmed away, and insecticide was sprayed directly to the remained branches and trunk one month ago.

Application method 1 (Soil drenching)

- Use a tape and place at the level of your chest to measure the tree circumference.
- Simply mix 10 gram of Q-Pest for every 4cm of diameter or 12cm of circumference at chest height
- Place enough amount of Q-pest in 4 liter of water.
- Pour the mixed solution around the base of the tree where it flows down over the root flare and directly around the base of the tree.
- Applications of Q-Pest made directly around the tree's trunk work most effectively in controlling insect pests

Application method 2 (Hole method)

- Use a tape and place at the level of your chest to measure the tree circumference.
- Simply mix 10 gram of Q-Pest for every 4cm of diameter or 12cm of circumference around the tree at chest level
- For every bag of Q-Pest 10gram water soluble pack, dig a hole 30cm from the base of the tree and 15cm in depth.
- Place the Q-pest in each hole, then cover it with soil
- Pour water on the base of the tree where it flows down over the root flare and directly around the base of the tree.

Application of control release fertilizer

For every 4cm of diameter or 12cm of circumference around the tree at chest level, apply 100g of Fairturf G (20-6-10+5MgO) on the top of the soil around the tree.

Treatments:

Tree number	"Q-Pest" application method	Fertilizer application
1	Soil drench	Yes
2	Hole method	Yes
3	Hole method	No
4	Soil drench	No
5	Soil drench	Yes
6	Hole method	Yes
7	Hole Method	No
8	Soil drench	No

Result evaluation:

By observation:

Take photo every week for each tree

Observe leaves and branches growth

By insect population: (perform every month)

Take leaf sample with galls from the trees (treated vs untreated)

Select galls without emergence (without or very little visible punctured holes)

Put galling sample in labeled container with clear cover.

Weigh and record sample weight

Keep sample at temperature between 25℃to 32℃ for at least 21 days for complete emergence

Under normal condition without honey (nectar), wasps only have 3 days of life

Under microscope, count the number of wasps

Data Sheet

On November 27, 2006, eight trees in Tai Hang Tung Estate Playground 2 had been treated with Q-pest. Details of insecticide application are as follows:

Tree no.	1	2	3	4	**5**	**6**	**7**	**8**
DBH (cm)	Dia.:32/3	Dia.:31/3	Dia.:32/3	Dia.:36/3	Dia.:42/3	Dia.:30/3	Dia.:33/3	Dia.:36/3
Pack of Q-pest Used (10g pack)	3 packs	3 packs	3 packs	3 packs	3 packs	3 packs	3 packs	3 packs
Fairturf-G Used	300g	300g			300g	300g		
Remark		✧ Hole digging method				✧ Hole digging method		
				✧ Convex ground ✧ heavy shrubs growing around the tree			✧ Flat ground ✧ Moderate shrubs growing around the tree	
	✧ Loose soil ✧ Flat ground ✧ Individual confined area ✧ Herbal plants growing on the ground			✧ Compact soil ✧ Grow on the same confined area ✧ Shrubs and bushes type plants growing on the ground				

Tree number 9 is outside the accessible area of Tai Hang Tung Estate Playground 2 where a construction site is. Therefore, Tree number 9 is considering as a control that compare with other treated trees

According to the study carried out in Hawaii by the research group from University of Hawaii, three methods of had been employed to evaluate the efficacy of the control of Erythrina gall wasp.

1. Observation of the tree with using five-point numerical rating system

Rating	Description	Approx gall weight per 20g of leaf
1	Very light infestation, only very slight galling	<3g
2	Moderate galling	3-8g
3	Heavy galling of leaves but minimal leaf deformity	8-14g
4	Heavy galling moderate leaf deformity	14-18g
5	extreme galling and deformity with no expanded leaves	>18g

2. Wasp emergence
   It was quantified by excising galls that lacked emergence holes and holding them in waxed paper bowl covered with silkscreen to prevent escape. Galls were weighed at the time of excision. Three weeks after collection, wasps were counted with the aid of a dissecting microscope. The number of wasps per gram of gall tissue could be calculated.

3. Imidacloprid content in leaves
   From the study in Hawaii, Imidacloprid concentration in leaf is inversely correlated with the emergence of wasp and five-point numerical rating system. When the imidacloprid concentration at the level below 1 ppm, the emerged wasps is at the level from 16 - 23 wasps per gram gall tissue, rating is 4 to 5. On the one hand, the emerged wasps level was down to 5 – 8 wasps per gram gall tissue, and rating become 1 to 2 when the imidacloprid concentration at 4 – 8 ppm.

Due to the limitation of this study, there are very few leaves on the trees. Using wasp emergence and imidacloprid content to evaluate the efficacy of the treatment is not practical. This is because very few leaves on the tree canopy can be picking up for study sample. We only employ the observation of the tree with using five-point numerical rating system. As the study result by University of Hawaii, the relationship between “5 point rating system” and wasp infestation is proportional, the higher rating point is meaning the heavier infestation.

Result and observation

Date	Observation rating (Tree number)								
	1	2	3	4	5	6	7	8	9
27 Nov, 2006	X -- No new leaf growth or very small amount of leaves growing. Wasp infestation are not representative and the condition of trees cannot be rated								
05 Dec, 2006									
15 Dec, 2006									
27 Dec, 2006									
09 Jan, 2007									
19 Jan, 2007									
31 Jan, 2007									
13 Feb, 2007									
26 Feb, 2007	0	X	1	X	X	X	X	1	0
05 Mar, 2007	0	X	1	X	X	X	X	1	0-1
19 Mar, 2007	0	X	1	0	1	X	0	1	0-1
04 Apr, 2007	1	0	1	0	1	X	1	1	1
12 Apr, 2007	1	0	1	0	1	X	1	1	2
19 Apr., 2007	1	0	1	1	1	X	1	2	3
2 May 2007	1	0	1	1	2	X	2	2-3	4

After application of Q-pest, all the trees had shown very little change until mid-February. Starting from March, tree #1, #3, #8 and #9 have new grown leaves at the top level of the trees. The five-point numerical rating system was then applied to evaluate the degree of infestation. On mid-March, tree #5, #7 and #9 had a new branch (leaves) at the mid level of the tree. Tree #4 and #2 were started to have new leaves in late March and early April respectively. In the observation on May 2, 2007, except tree #6, all trees have new grown leaves and branches. The five-point numerical rating system became more relevant and applicable.

- Compare with the control tree #9 (rated 4), all trees treated with Q-Pest (rating 0 to 2) (except tree #6) have better result than untreated tree.

- In the same treated tree, the new grown leaves at the mid-level or inner position of canopy has minor or even no gall wasp infestation, but heavy gall wasp infestation can be found on the top level or outer position of the tree canopy.

- Compare with the application methods, tree #1 and #5 was using soil drenching, and tree #3 and #7 was using hole digging method. We consider tree #1 and #3 as a compared pair, and tree #5 and #7 as another compared pair; This is because the Have very similar in growing environment (see the remark in data sheet). Both trees pair does not show any major difference in wasp infestation.

Tree number	1	3	5	7
Method Use	Drenching	Hole method	Drenching	Hole Method
Rating on May	1	1	2	2

- Compare the trees in different growing environment, we consider tree #1, #2 and #3 is a same group, and tree #4, #5, #6, #7 and #8 is a second group. The growing environment of the tree could affect the growth and the efficacy of the Q-Pest treatment.

<table>
<tr><td>Tree number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td rowspan="2">Growing environment</td><td colspan="3" rowspan="2">✧ Loose soil
✧ Flat ground
✧ Individual confined area
✧ Herbal plants growing on the ground</td><td colspan="3">✧ Convex ground
✧ heavy shrubs growing around the tree</td><td colspan="2">✧ Flat ground
✧ Moderate shrubs growing around the tree</td></tr>
<tr><td colspan="5">✧ Compact soil
✧ Grow on the same confined area
✧ Shrubs and bushes type plants growing on the ground</td></tr>
<tr><td>Leaves density on March</td><td>light</td><td>Very light</td><td>medium</td><td colspan="3">light</td><td>Very light</td><td>Very light</td></tr>
<tr><td>Leaves Density on May</td><td>Heavy</td><td>Light</td><td>Heavy</td><td colspan="3">Light</td><td>None</td><td>Light</td></tr>
<tr><td>Rating on May</td><td>1</td><td>0</td><td>1</td><td>1</td><td>2</td><td>X</td><td>2</td><td>2-3</td></tr>
<tr><td>Galls distribution</td><td colspan="3">Small amount of galls were found on the outer canopy of tree #1 and #3.</td><td colspan="5">Except tree #6, most of the galls were found on the top level of the tree. At mid-level of trees (tree #5 and #7), only small amount or even no gall found</td></tr>
<tr><td>Remark</td><td colspan="8">Tree #2 and #6 are covered by the tall trees around them.</td></tr>
</table>

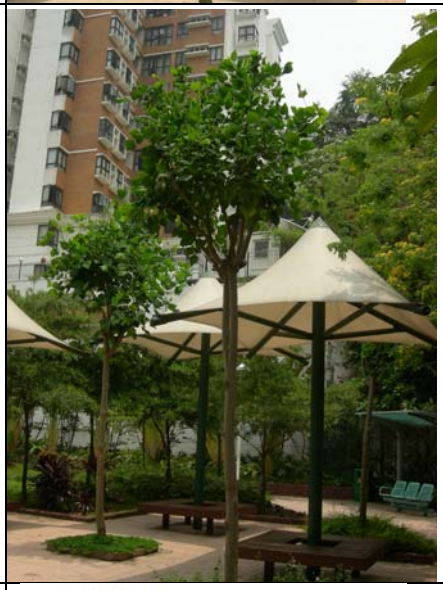
Discussion

Compare our study with the study conducted in Hawaii. Both results are very similar. Imidacloprid—the active ingredient of Q-Pest can control the infestation of Erythrina gall wasp. With using different application methods, the result is very similar. From the study result in Hawaii, tree injection has faster response than soil drenching methods. That is agreeing with our study result. Positive results were shown 4 months after treatment. Besides, Soil drenching does not show better result than using hole digging method.

With using hole digging method, all Q-Pest are packed in Water Soluble Bag and put into the dug hole. Finally, the Q-Pest is cover with at least 6-inches soil. The treatment procedure does not involve any direct contact of Pesticide, and no pesticide is exposing to avoid any unwanted public contact. Due to the situation in HK, treatment areas are always urban green area which is populated and closing to children playground. Hole digging method has a big advantage on safety consideration, not only in the occupational safety, the general public safety are also included.

In term of the growing environment, the compact soil condition, heavy bushes growing under the trees have adverse effect on the tree growing, and, also lowering the efficacy of Q-Pest. This is because the treat trees are more difficult to absorb the Q-Pest when the soil texture is very compact. And, heavy bushes have greater competition on Q-Pest and nutrient uptake. Besides, the convex ground cannot hold the Q-Pest water mixture and flow away from the treated trees, thus, the inefficiency of Q-Pest absorption lead to the unsatisfactory result.

Although, imidacloprid—active ingredient of Q-Pest, is the most satisfactory systemic insecticide for EGW control, unfortunately, the control of EGW by Q-Pest is not 100%, To avoid the outbreak of EWG infestation and eliminated the species of Erythrina variegate in Hong Kong, routine treatment for with Q-Pest may require once a year. In case of different situation of the Erythrina variegate, such as compact soil, ground contour and surrounding plants, hole method application may not be the best option. A better alternative may be tree trunk injection which was used in Hawaii study.

Tree no.	5 Dec, 2006	2 May 2007
1		
3		
9		

Tree no.	5 Dec, 2006	2 May 2007
5		
7