Kusagikamemushi in Japan

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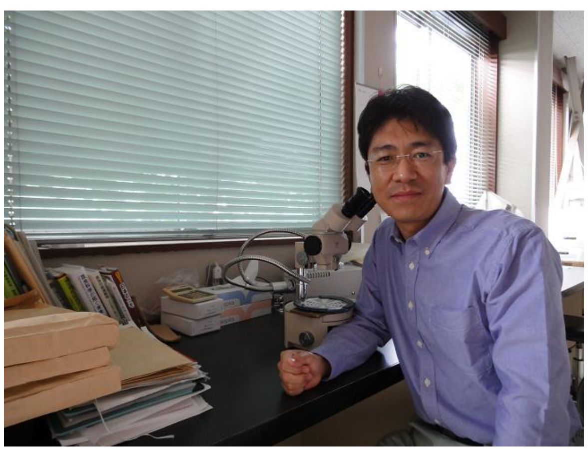
Ken Funayama

- Ph.D.: Okayama University, Japan (Applied Entomology)
- Research on BMSB since 1996
- 10 published manuscripts on BMSB with more submitted and in prep
- Communication via email from: 12/2009 to present



Halyomorpha halys Status in Japan

- *Plautia stali* most important stink bug overall
  - Larger numbers
  - Southern and western Japan
- *Halyomorpha halys* most important in northern Japan
  - Outbreak pest (1996, 2001, 2010 (southern only), 2011(northern?))
  - Minimal research
    - Ecology of bug/parasitoids, pheromone isolation and nuisance

Seasonal Phenology

April to May

- Leave overwintering sites
  - Depletion of resources
  - Temp. and photoperiod
    - Induction of diapause and gonad reduction

May to June

- Mating and egg-laying

1 generation in northern Japan (Akita)

- Adults emerge August to September

2 generations in southern Japan (Chiba)

- 1^{st} gen adults: early July to Aug.; 2^{nd} gen adults: late Aug to Oct.

September to mid-November

- Adults head to overwintering sites
- Nymphs and low temps.

In general, adults most active in fruit blocks at dusk

Mating

Mating begins in May and egg-laying begins mid-May to early June.

- Egg-laying occurs after 14L:10D and min. temp. for ovary development is ~16°C
- 14-15 d pre-oviposition period reported under lab conditions for newly emerged adults
- ~ 5 copulations/day
- Males tend to copulate at ≥1 hr intervals while females do not appear to have a time delay
- Females lay eggs at approximately 4-5 d intervals
- Mating occurs throughout the day, but reported increases between 11 pm and 6 am
- Females mated only once are capable of laying fertile eggs for half of their lifespan; however fecundity is decreased

Mating behavior:

1. Male starts to approach female and taps on substrate
2. When male approaches he touches female with antennae and taps on her body
   a. Behavior continues until female is receptive or he finds another female
3. Once female is receptive the male walks over her and continues to tap
4. The male then attempts to lift her abdomen up with his head and if receptive the female raises her abdomen
5. The male turns around and raises his abdomen to the corresponding height and begins copulation…sometimes continuing to tap on her body with his legs
6. Copulation lasts for approximately 10 min.

Trapping/Monitoring

- Growers do not regularly monitor for BMSB
- Yellow bucket traps and pyramid traps used commercially
- Some use of mercury lamp light trap
- Optimum trap height placement is 2 m
- Peak captures in mid-May to early June and early to mid-September
  - Female ovarian development and nutritional level of captured adults is significantly lower than those collected on hosts
- Use methyl (*E,E,Z)*-2,4,6-decatrienoate (*P. stali*) pheromone
  - Pheromone believed to be active to at least 12 m

Hosts I

- 50+ plant species reported – tree fruit, vegetables, wild hosts
  - No information on non-hosts
- "Preference":
  - Nearly mature/mature fruits
  - Growers say peach and pear over apple
  - Wild cherry and *Paulownia* based on ability to complete development and commonly observed on these plants
  - Commonly observed on Japanese cedar and Japanese cypress, but cannot complete development
  - No known published reports

Hosts II

- Nymphs and adults known to travel between hosts throughout season
  - Published reports of increased survivorship in lab when fed a diet of multiple foods versus single food source
    - Adults produce fewer eggs when fed apple over Japanese flowering cherry
  - More common in apple in May and wild landscapes from June to early July
- *Paulownia tomentosa* and numerous species of wild cherry observed as hosts for sexual reproduction
  - Cherries bloom from April to mid-May with fruit available until mid-September
  - Commonly observe eggs, nymphs and adults from June-September
  - *Paulownia* and wild cherry (specifically *Prunus grayana*) considered “complete host plants”

Damage

- Percent injury varies year to year
- In 2001, during outbreak year, 75% of apple growers had ≤5% injury and only 3% of growers had >11% injury
- Severe injury usually attributed to BMSB

Commercial Management

- Based on guidelines for *P. stali* in southern Japan

If density of overwintered *H. halys* is high:

- Use pyrethroids and neonicotinoids from April in plum, May in peach and apple, and July for pear, persimmon and tangerine
- Hasten to bagging of fruit
- Leave more fruit during thinning
- Turn on repellent lights early (not considered as effective against *H. halys*) – mostly used in southern Japan

If density of overwintered *H. halys* is low:

- Use normal spray program
- Do not use pyrethroids

Reports of pear growers covering trees with netting

Density of Overwintering Population

- Anecdotes of bugs at man-made structures
- Traps placed in hibernation sites
  - Plastic containers packed with bundles of rice straw
    - Mean # BMSB captured prior to “outbreak” year = 6020
    - Mean # BMSB captured in other years = 1940

Chemical Control in Apple

- Commonly used for other pests:
  - Cyhalothrin, Acetamiprid, Thiacloprid and Clothianidin
- Commonly used for *H. halys:*
  - Dinotefuran, Thiamethoxam, Clothianidin, Bifenthrin, Fenpropathrin, and Silafluofen
  - Growers target mid-May to early June and July through August
  - Alternate row middle sprays
  - Some insecticides used within 1 week of harvest

Chemical Efficacy I

- Translated portion from “Fruit bugs interesting biology and wise technique of control (2003)”

Chemical	Contact	Residual
Bifenthrin	A	A
Silafluofen	A	A
Cypermethrin	A	B
Permethrin	A	B
Cyhalothrin	A	B
Cyfluthrin	A	B
Fenpropathrin	A	B
Fenvalerate + Dimethoate	A	B
Etofenprox	A	C
Diazinon	B	?
Chlorpyrifos	B	?
Dinotefuran	B	A
Thiamethoxam	B	A
Imidacloprid	B	B

Chemical Efficacy II

- Two published reports of dinotefuran having greater residual control in field trials than thiamethoxam.
  - Up to 12 days with at least some efficacy from dinotefuran
- Residual control in field from acephate = 3 d

Chemical Efficacy III

Chemical	Contact LC_{50} ppm	Residual LC_{50} 48 h ppm
Bifenthrin	1.19	4.30
Thiamethoxam	5.25	22.02
Imidacloprid	9.59	40.9
Dinotefuran	9.74	28.4
Fenpropathrin	11.05	29.24
Cypermethrin	14.39	32.42
Clothianidin	14.40	43.55
Acetamiprid	17.84	304.31
Thiacloprid	22.15	125.76
Permethrin	24.25	54.14
Silafluofen	39.28	61.29

Chemical Efficacy IV

Field testing

- **Conventional program:** phenthoate (mid-May), thiacloprid (mid-June), chlorpyrifos (late June), cyhalothrin (early July), and methidathion (late July)
- **Test program:** dinotefuran (mid-May), thiacloprid (mid-June), fenpropathrin (late June), dinotefuran (early July), and bifenthrin (late July)
- **Results:** 80% fewer feeding sites in test program, bugs observed in trees within 3 days of conventional program treatment and 6 days in test program

Biological Control

- *Trissolcus itoi* (80%)*, T. mitsukurii* (96%)*, T. plautiae* (70%)* (Scelionids) @ 20-27.5°C
  - 11-15 generations per year
- *Ooencyrtus nezarae* (Encyrtid)
- *Anastatus gastropachae* (Euplemid)
- *Bogosia* sp. (Tachinid) – nymph and adult parasitoid
  - Attacks both diapausing and non-diapausing adults
- Spiders and Reduviids (*Isyndus obscurus)*

Nuisance Management

- Hand removal
  - Kerosene dip
- Coroplast slit traps
- Application to exterior of home/windows or treatment of polyethylene sheet applied to windows or screened net covering structures :
  - Cyphenothrin, prallethrin, phenothrin, and DEET

Random Information

- Red abdominal coloration
  - Erythropterin
  - Increased age and exposure to long day conditions
  - Niva, C.C and M. Takeda. 2002. Color changes in *Halyomorpha brevis* correlated with distribution of pteridines: regulation by environmental and physiological factors.

質問　　　　**コメント**