

IPM in Aquatics, Natural Areas and Rights-of-way

A wide-angle photograph of a vast pond filled with yellow lotus flowers. The water is dark, and the lotus leaves are large and green, floating on the surface. The sky is blue with scattered white clouds. The horizon is flat and distant.

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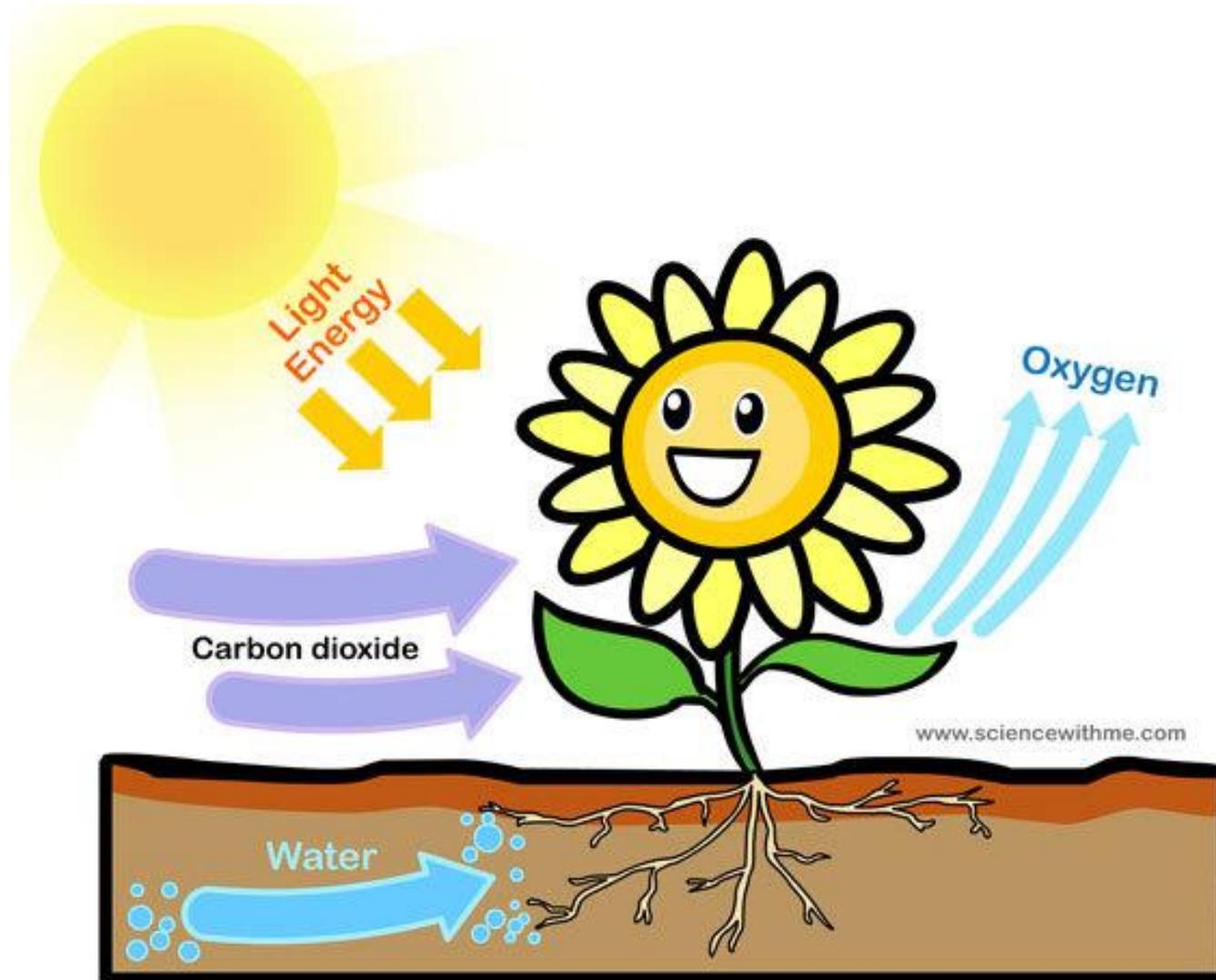
What is IPM?

- Integrated Pest Management
- All the tools in the toolbox
 - Cultural
 - Mechanical
 - Biological
 - Chemical



Cultural control

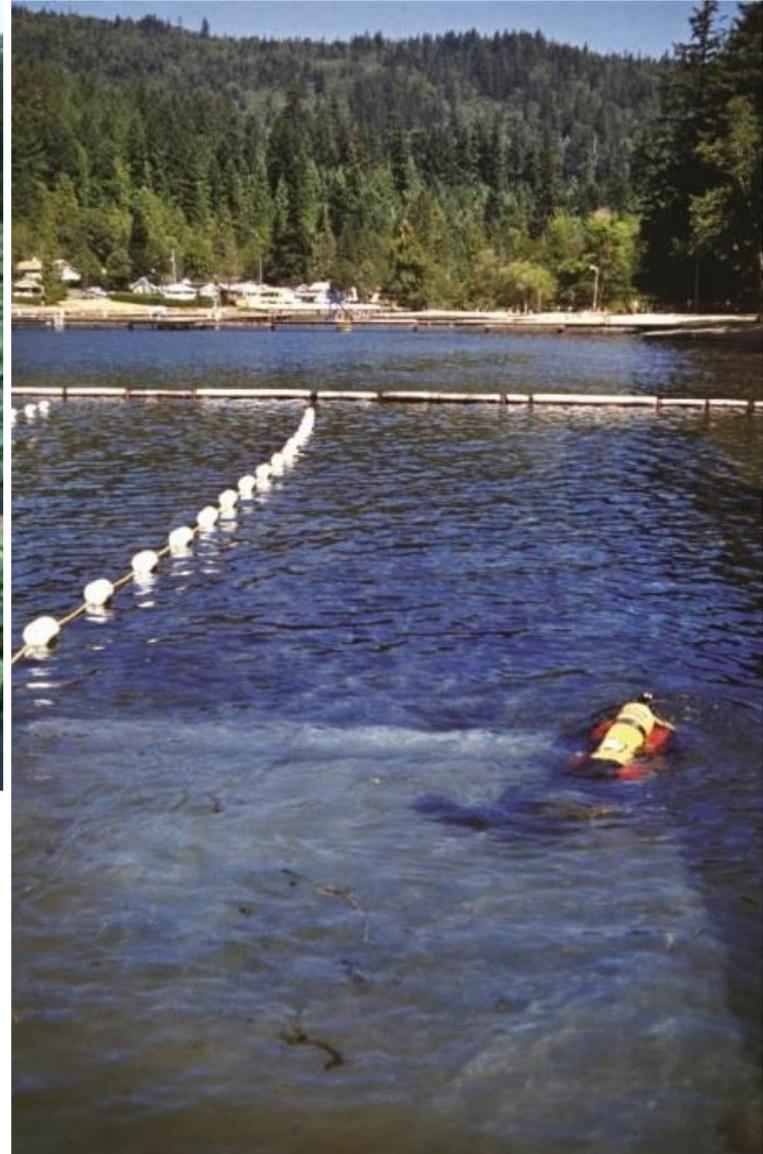
- Growing requirements/cultural conditions



Cultural control: mulches



Cultural control: barriers



Cultural control: drawdown



Cultural control: other



Mechanical control

- Disrupt, damage or remove



Mechanical control: digging



Mechanical control: cutting



Hold Here



Mechanical control: cultivate/chop



Mechanical control: burning



Red Dragon Vegetable Bed Flar



Mechanical control: harvesting



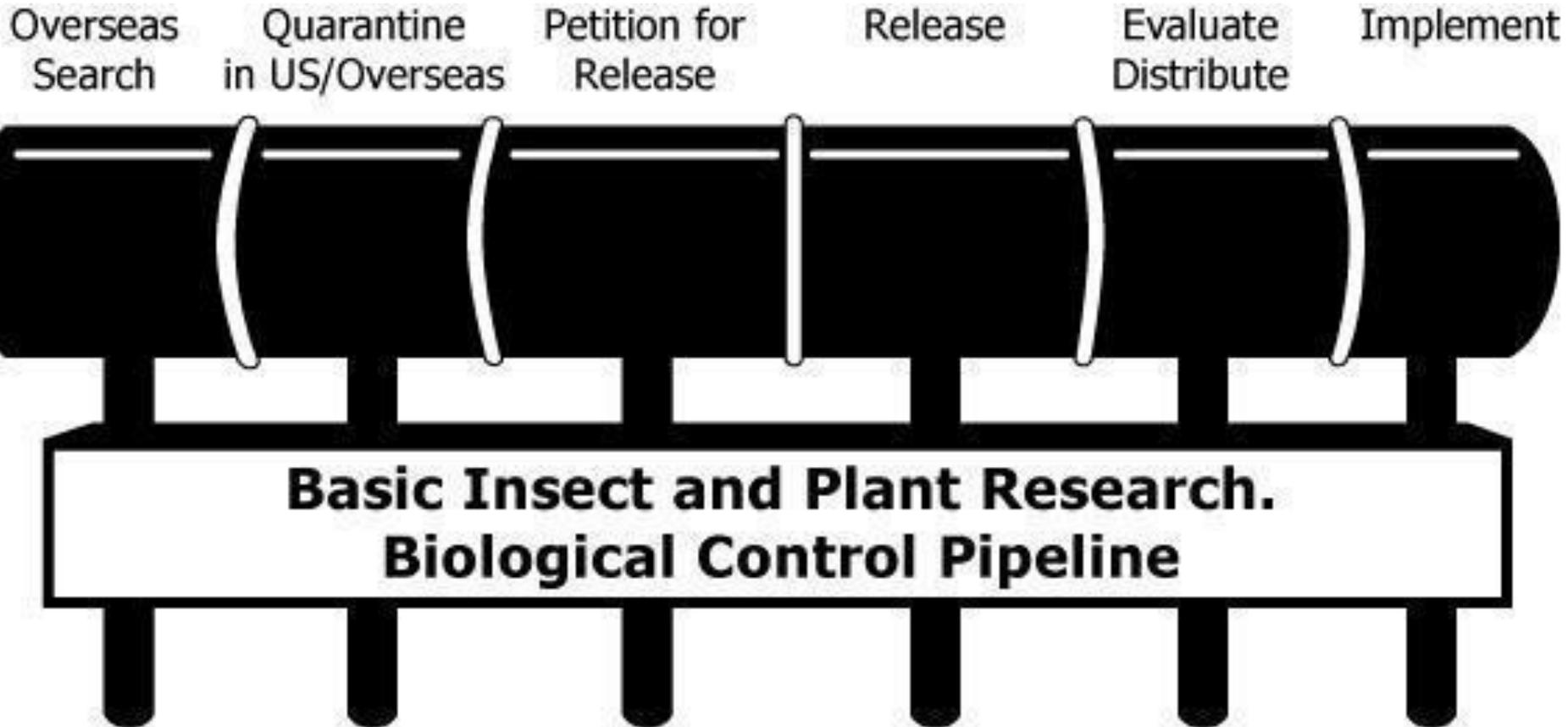
Biological control

- Natural enemies



Biological control requirements

- Host-specific
- Self-sustaining



Chemical control

- Herbicides
- Act on plant processes
 - Photosynthesis
 - AA/protein production
 - Respiration
 - Hormones/growth processes



Chemical control

- Systemic vs. contact
- Foliar vs. submersed/water column
- Aquatic: 16 a.i.
- ROW/NA: more
- Crops: 200+

IPM toolbox

- Cultural
- Mechanical
- Biological
- Chemical



IPM in practice



Alligatorweed

- *Alternanthera philoxeroides*
- S. America late 1800s



Alligatorweed



- Cultural: not really
 - Barriers – too big, indiscriminate
 - Drawdowns – “all-terrain”
 - Hand-pull – fragile, roots, sections, fragments
- Mechanical: not really
 - Cutting – fragments
 - Burning – not in aquatics

Alligatorweed



- Chemical: yes!
 - Imazapyr (2003), imazamox (2008)
 - Glyphosate (1977), triclopyr (2002)
- Note: only glyphosate until 2002
- Biological: yes!
 - Beetle, stem borer (moth)
 - Thrips (not very effective; terrestrial)

Alligatorweed

- Alligatorweed flea beetle
 - *Agasicles hygrophila*
 - Argentina (1964)
 - South: near-complete
 - North: negligible



- Alligatorweed stem borer
 - *Arcola* (= *Vogtia*) *malloi*
 - Argentina (1971)
 - Upper Mississippi Valley



Alligatorweed



Hydrilla

- *Hydrilla verticillata*
- Asia 1950s



Hydrilla



- Cultural: sometimes
 - Barriers – huge areas, indiscriminate, tubers, turions
 - Drawdowns – ok but indiscriminate
 - Hand-pull – fragile, roots, sections, fragments
- Mechanical: sometimes
 - Cutting – fragments
 - Harvesting – limited, indiscriminate, by-catch, disposal

Hydrilla



- Chemical: yes!
 - Fluridone*** (1986)
 - Endothall (1960), diquat (1962)
 - ALS (imazamox, penoxsulam, bispyribac – 2000s)
- Biological: yes!
 - Weevils, midge, flies, moth
 - Grass carp

Hydrilla

- Two weevils
 - *Bagous affinis* – India (1987)
 - *B. hydrillae* – Australia (1991)
 - Not established
- Hydrilla tip mining midge
 - *Cricotopus lebetis*
 - Unknown – adventive
 - Negligible but damages growing tips



Hydrilla

- Two flies
 - *Hydrellia balciunasi* – Australia (1989)
 - *Hydrellia pakistanae* – India (1987)
 - Negligible; *H. pakistanae* widely distributed on DH

- Parapoynx moth
 - *Parapoynx diminutalis*
 - Asia – adventive
 - Negligible but occasional heavy damage
 - Indiscriminate



Hydrilla

- Grass carp
 - *Ctenopharyngodon idella*
 - China (1963)
 - Substantial; indiscriminate
 - Triploid only; requires permit



Hydrilla IPM

- RAMP (Risk Avoidance & Mitigation Project)
 - UF/IFAS Research and Extension
 - USACE
 - FAMU
 - USDA \$\$\$
- Integrated strategy
 - Herbicide
 - Insect
 - Fungus



Hydrilla

- Herbicide
 - Imazamox → branching → tips
- Insect
 - *Cricotopus lebetis* midge → damages tips
- Fungus (native)
 - *Mycoleptodiscus terrestris* → attacks damaged tips



Waterhyacinth

- *Eichhornia crassipes*
- S. America late 1800s



Waterhyacinth

- Cultural: not really
 - Barriers – not for floating plants
 - Drawdowns – triggers seed germination
 - Hand-pull – small populations

- Mechanical: sometimes
 - Harvesting – limited, indiscriminate, disposal



Waterhyacinth

- Chemical: yes!
 - 2,4-D, triclopyr, diquat, glyphosate
 - ALS (imazamox, imazapyr, penoxsulam)
- Biological: yes!
 - Weevils
 - Moths, mites (negligible effects)
 - Plant hopper



Waterhyacinth

- Two Argentine weevils
 - *Neochetina bruchi* (1974)
 - *Neochetina eichhorniae* (1972)
 - Widely distributed; substantial damage



- Plant hopper
 - *Megamelus scutellaris*
 - S. America (2010)
- May reduce herbicide rate



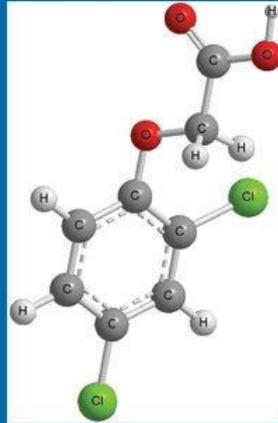
Waterhyacinth



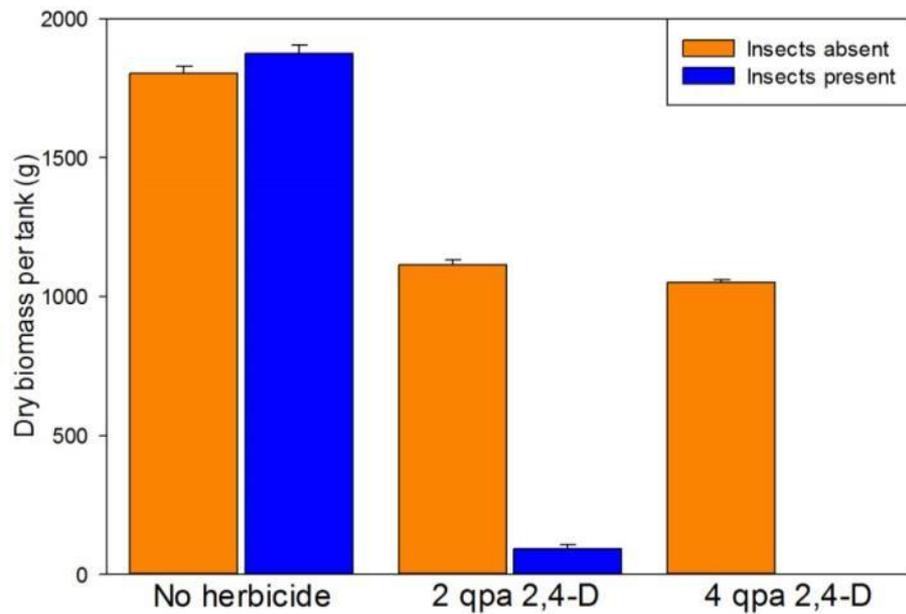
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Waterhyacinth IPM

2,4-D



+



Melaleuca

- *Melaleuca quinquenervia*
- Australia late 1800s
 - Wet feet, high and dry
 - Leaves simple, elliptic
 - Smooth margins
 - Alternate arrangement
 - Tree with papery bark
 - White bottlebrush flowers



Melaleuca



melaleuca
Melaleuca quinquenervia
Photo by Ann Murray
© 2006 University of Florida



Young melaleuca trees
spreading in Everglades
Photo by Randall Stocker
Copyright 1997 University of Florida

ria
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Melaleuca



- Cultural: sometimes
 - Mulches – no effect on mature trees
 - Drawdowns – “all-terrain”
 - Hand-pull – may not be practical or accessible
- Mechanical: sometimes
 - Cutting – hard to get to, dense thickets
 - Burning bad – volatile oils; burn hot to the canopy, trees survive, throw seeds, smoke allergenic

Melaleuca

- Chemical: yes!
 - Imazapyr, glyphosate, triclopyr
 - Cut stump, hack/squirt, fringe/girdle



- Biological: yes!
 - Weevil, psyllid
 - Flies (not very effective or not established)



Melaleuca

- Melaleuca weevil
 - *Oxyops vitiosa* (Australia, 1997)
 - Substantial damage – new leaves
 - Can't establish in permanently flooded sites



- Melaleuca psyllid
 - *Boreioglycaspis melaleucae* (Australia, 2002)
 - Substantial damage



Melaleuca



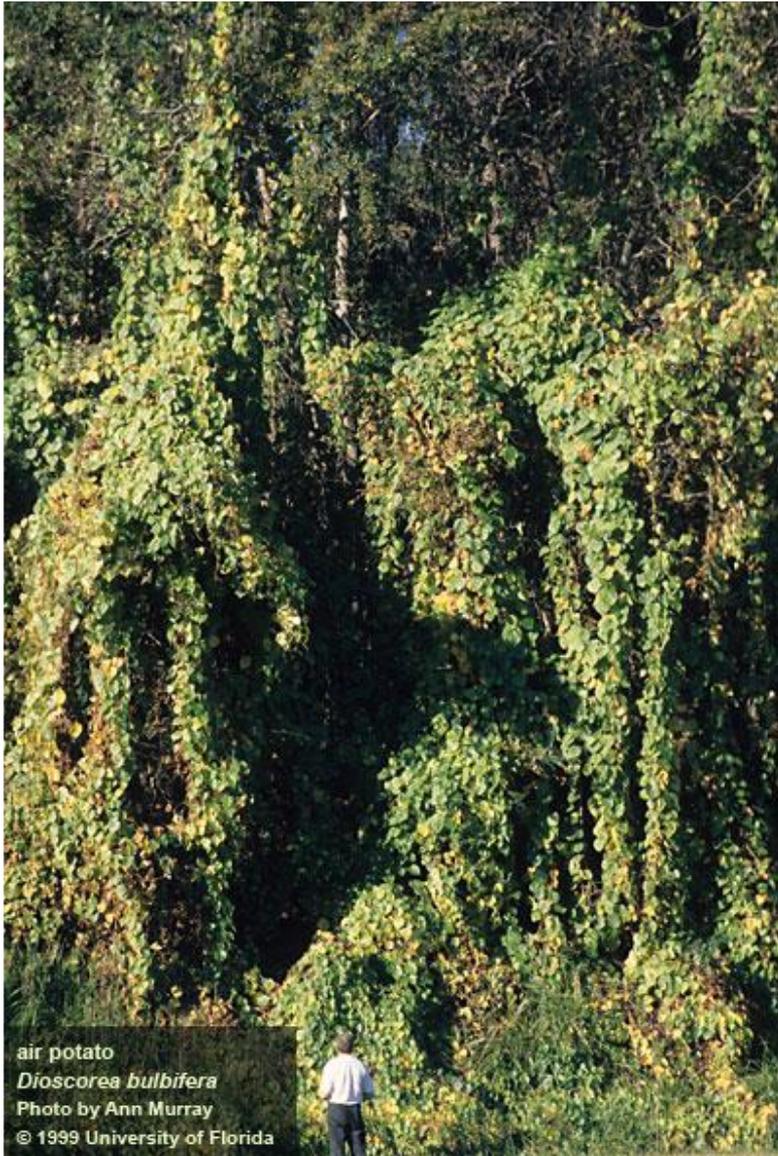
Oxyops damage on *Melaleuca quinquenervia*
Photos by Vic Ramey
Copyright 2002 Univ. Florida

Air potato

- *Dioscorea bulbifera*
- Asia 1905
 - Herbaceous vine to 70'
 - Leaves simple, cordate
 - Smooth margins
 - All veins arise from leaf base
 - Alternate arrangement
 - Aerial bulbils



Air potato



Air potato



- Cultural: sometimes
 - Mulches – no effect
 - Collect bulbils – so many... some buried
 - Hand-pull – may not be practical or accessible
- Mechanical: sometimes
 - Cutting/mowing (8"/day; also may spread)
 - Burning damages native “scaffolding”

Air potato

- Chemical: yes!
 - Glyphosate, triclopyr
 - Off-target damage



- Biological: yes!
 - Leaf beetle



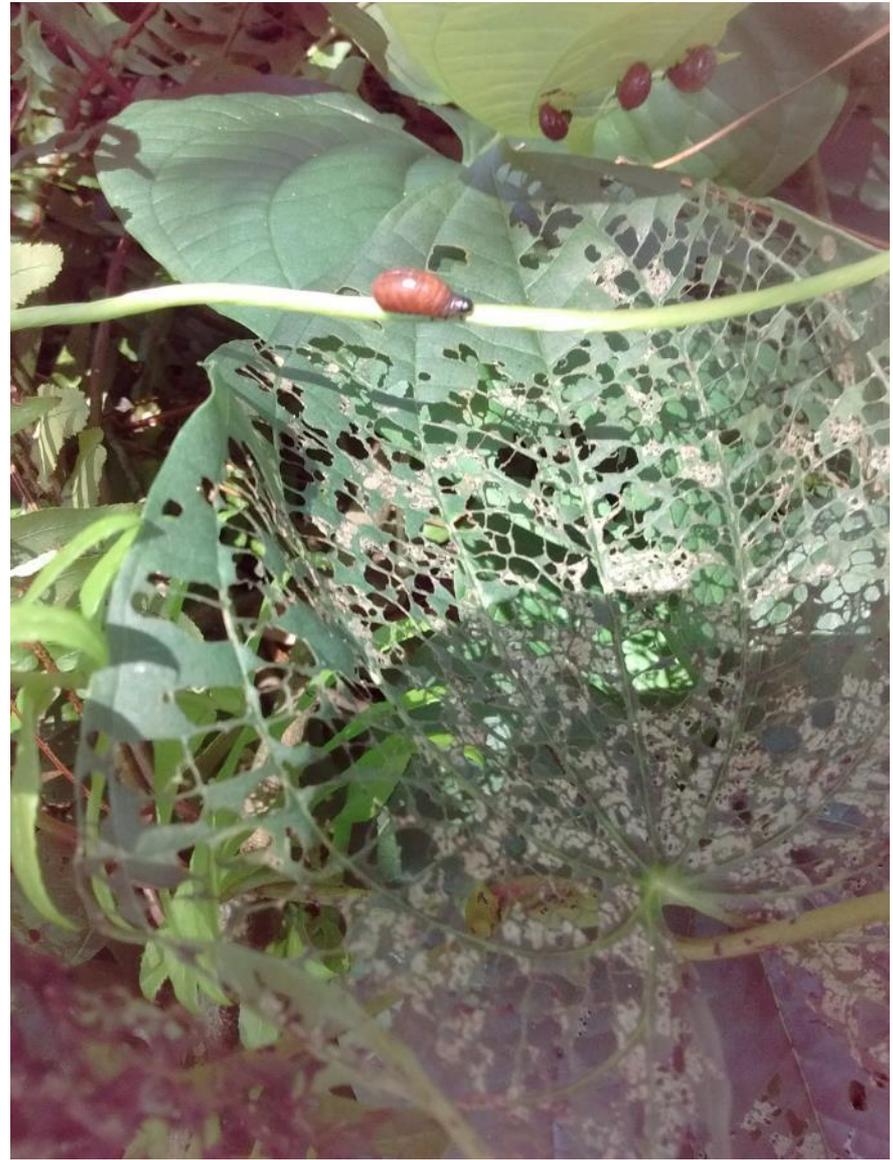
Air potato

- Air potato leaf beetle
 - *Lilioceris cheni* (Asia, 2011)
 - Substantial damage
 - Rarely feed on bulbils



Adult *Lilioceris cheni*, left: Chinese and right: Nepalese. Photo by W. Overholt.

Air potato



Other species with biocontrol agents

- Tropical soda apple – beetle



Tropical soda apple
Solanum viarum
Photo by Ann Murray
© 2000 University of Florida

Other species with biocontrol agents

- Brazilian pepper – wasp (adv)



Brazilian pepper-tree
Schinus terebinthifolius
Photo by Ann Murray
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Other species with biocontrol agents

- Waterlettuce – weevil



Other species with biocontrol agents

- Salvinia – weevil



Take home message

- Lots of weeds – water and land
- Some tools, never enough
- Use an integrated approach when possible
- Try new things!
- Safety first!!!



A wide-angle photograph of a vast pond filled with lotus plants. The water is dark, and the lotus leaves are large, round, and green. Numerous yellow lotus flowers are in various stages of bloom, scattered across the pond. The sky is bright blue with many white, fluffy clouds. The horizon is flat and distant.

Thanks! Questions?

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