



United States Department of Agriculture

Plants: Friends and Foes. A Discussion of Ongoing Issues & Emerging Concerns

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Presentation Outline

- Introduction
- Ongoing Issues & Emerging Concerns
- Questions & Discussion:
 - What can we do?
 - What should we do?
 - What to prioritize?



Plants are important



Plants are important

Unlike most other
organism groups, we
(generally)
intentionally
introduce, breed,
spread, & promote
plants!



Dr. David G. Fairchild

USDA Botanist & Plant Explorer

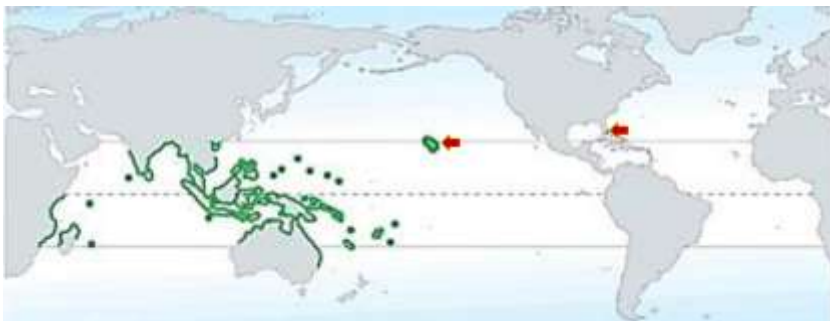
- Established the Office of Seed and Plant Introduction in USDA
- Responsible for the introduction over 200,000 exotic plants and crops
- Established the Chapman Field Research Station in Miami, Fl.
- Married Marian Bell



Fairchild's Home

The Kampong

- Built their home in 1926 in Coconut Grove, Florida
- Planted an amazing garden
- In 1940 he planted Orange Mangrove





Plants sometimes escape & naturalize!!

Region	#Natives	#Naturalized	% of Flora
Florida	3,270	1,473	31%
North Carolina	3020	836	22%
California	4,200	1,800	30%
Massachusetts	1,538	725	32%
US (50, +PR, +VI)	19,237	6,403	25%

Concepts - Plants sometimes go bad!!



- Weedy, invasive, or harmful in other ways
- The 10's rule (Williamson & Fitter 1996)
 - Introductions → Escape → Naturalize → Pests
- Time lags in invasions (Kowarik 1985)





- Reduce biodiversity
- Change habitat structure
- Alter ecosystem processes



- Reduce yield & damage crops
- Increase costs of production
- Interfere with harvest
- Impact trade





Water hyacinth jam at Fisheating Creek
Photo J. Schardt
2003 Florida D.E.P.



Aquatic plant chopping machine



- Impact human health
- Nuisance in gardens
- Restrict recreation
- Damage infrastructure

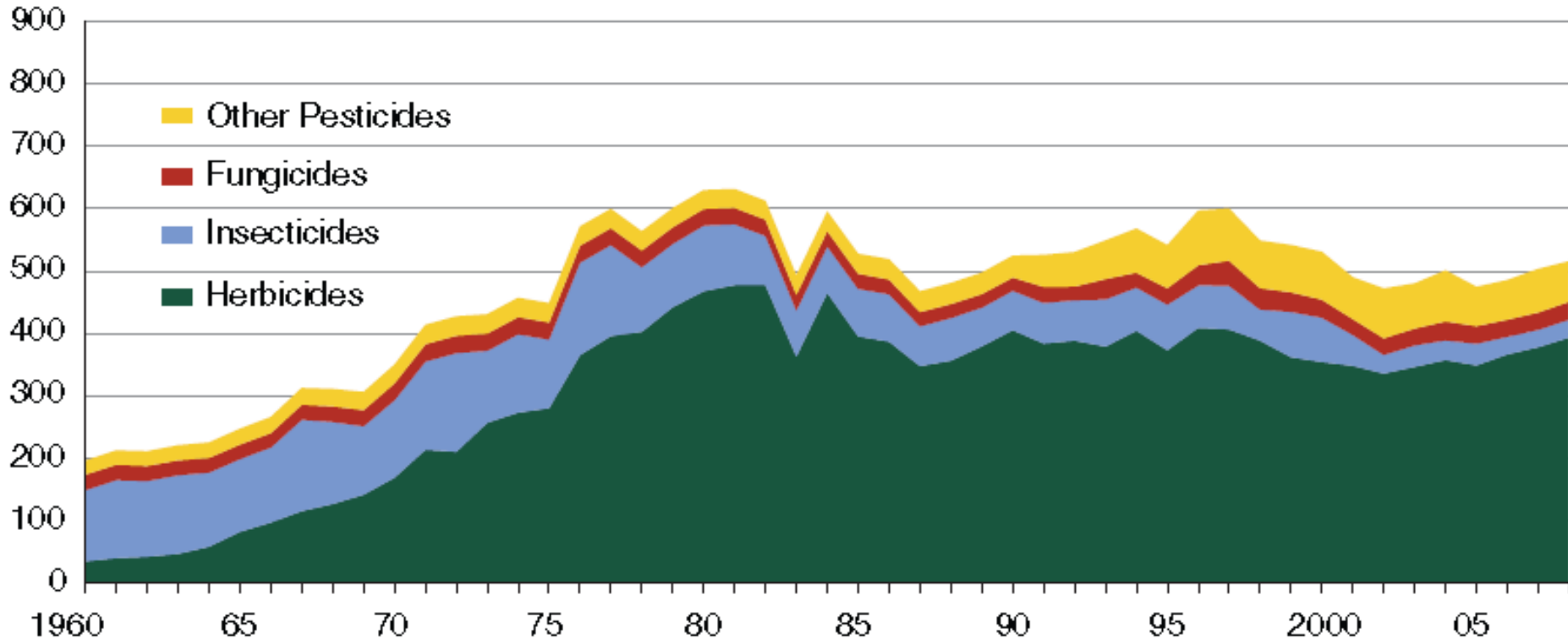
Economic Costs

Weeds cause direct and indirect losses of about...

- **U.S.: \$20-34 billion per year** (Gunn and Ritchie 1988; Pimentel et al. 2000).
- **Australia: \$3.5 – 4.5 billion per year** (Sinden et al. 2004).
- **58 Canadian crops: \$1 billion annually** (Swanton et al. 1993).
- **Costs are likely underestimated because they ignore environmental and social impacts.**

Pesticide Use in U.S. Agriculture, 21 selected crops, 1960-2008

Million pounds of pesticide active ingredient



(Fernandez-Cornejo, et al. 2014. USDA-ERS)



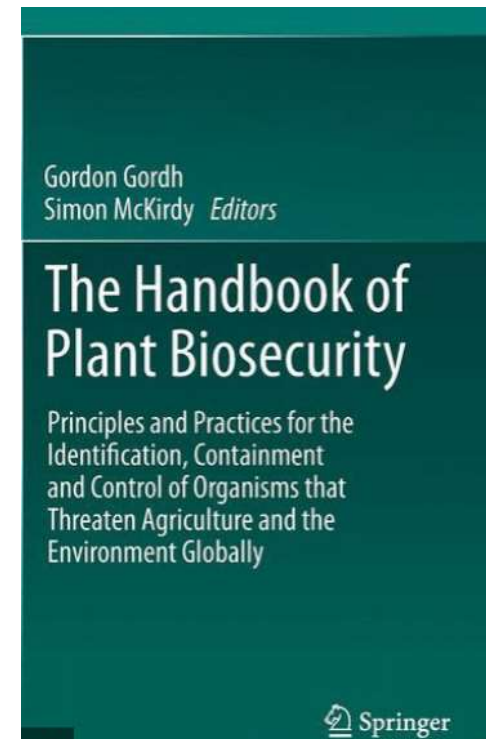
Management of natural-area invaders is more challenging



National Plant Protection Organizations

Protect plant resources from the entry, establishment, and spread of plant pests (including weeds and invasive plants)

- Identify threats
- Prepare risk assessments
- Inspect, & enforce regulations
- Develop emergency response plans
- Create quarantines
- Eradicate and contain
- Outreach & education
- Develop standards
- Develop & transfer technology



Looking Down the Road: Ongoing, New, & Emerging Weed Issues

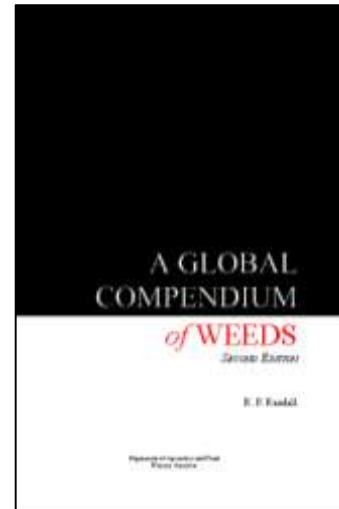


Unanalyzed Potential Threats

- Horizon scanning for exclusion targets.
- U.S.: 19,237 native species, 6,403 naturalized/established



300K – 350K species



22,000 species
that have been
reported as
naturalized, weedy,
or invasive

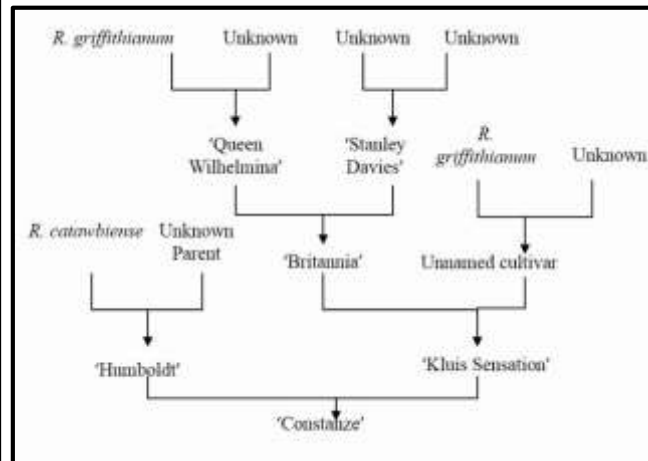
An important task. But how can we accomplish this with our limited resources? Should we take a regional approach to screening these species to determine which pose a significant risk?

Philydrum lanuginosum
– Woolly
Frogs Mouth



Hybridization, Hybrids, and Polyploidy

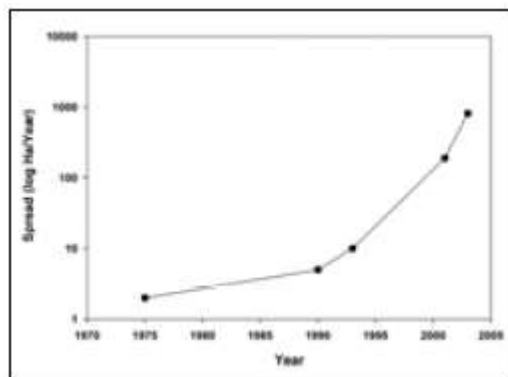
- Hybridization: The process where two different organisms (varieties, species, genera, etc.) cross through sexual reproduction to produce a hybrid offspring.
- Hybrid vigor (heterosis): The tendency of crossbred progeny to be more robust (i.e., vigorous) than either parent.



Some hybrid plants become invasive, or are more invasive than either parent. (Stebbins 1942, Baker 1965, Abbott 1992)



Spartina alterniflora x *S. foliosa* – Hybrid smooth cordgrass grows taller, denser, and faster than either parent.



Mercurialis annua ($2n=20$)

Mercurialis annua subsp. *ambigua* ($2n=40, 60$)

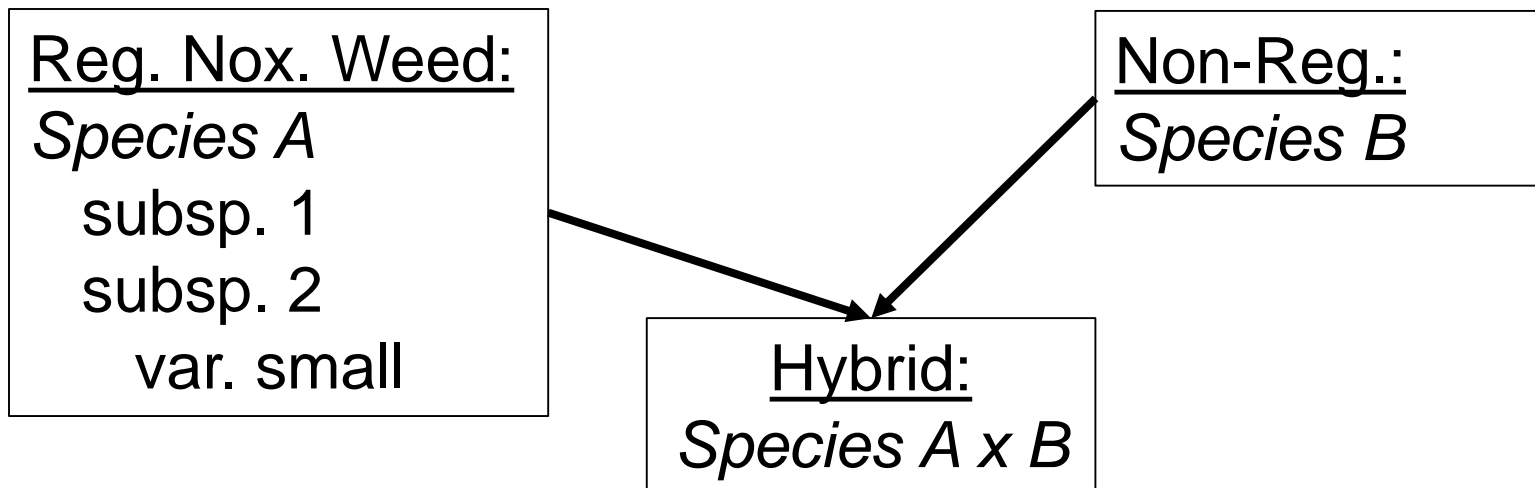


Toxic, allelopathic, reduces crop yield, weed of nurseries

Source: Dean Kelch, CDFA

Hybridization, Hybrids, and Polyploidy

How or should hybrids of already regulated noxious weeds be addressed?



Multiple Weed & Invasive Plant Lists

State Depts. of Ag.



Inv. Plant Councils



- Native Plant Societies
- Weed Science Societies
- Weed County Boards
- Other NGOs

Multiple Weed & Invasive Plant Lists

Fox et al 2003: Listing of weeds and invasive plants by some groups is not always transparent and may be based on expert opinion.

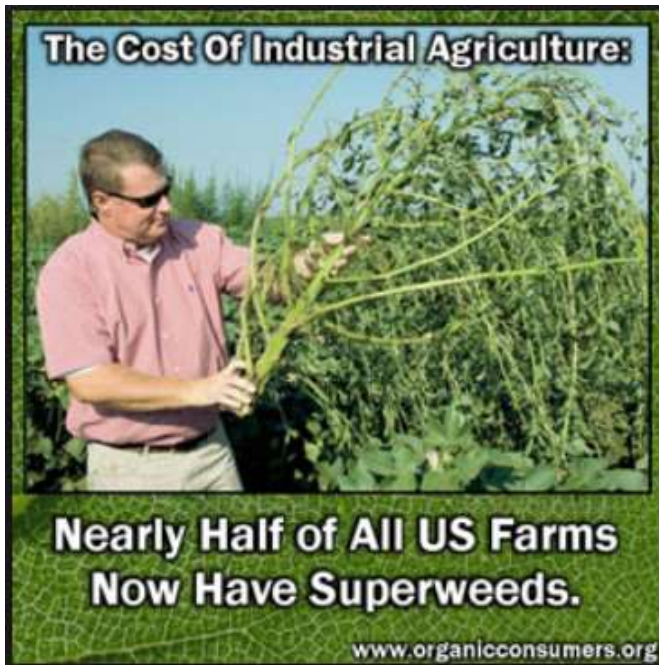
U.S. Stakeholder comment on a noxious weed rule (2001):

Requested that APHIS work to ensure that States are basing their individual weed lists on sound scientific research. Concern over the proliferation of lists and the lack of sound science.

Quinn et al 2013: “Recommend allocating listing authority to invasive species councils and provide guidance for the science-based reform of noxious weed lists”

As NPPOs, what kind of guidance can we provide here?

Herbicide Resistance in Weeds



Dispersed within fields by machinery

Dispersed as contaminants in seed & grain
(Shimono et al. 2015)

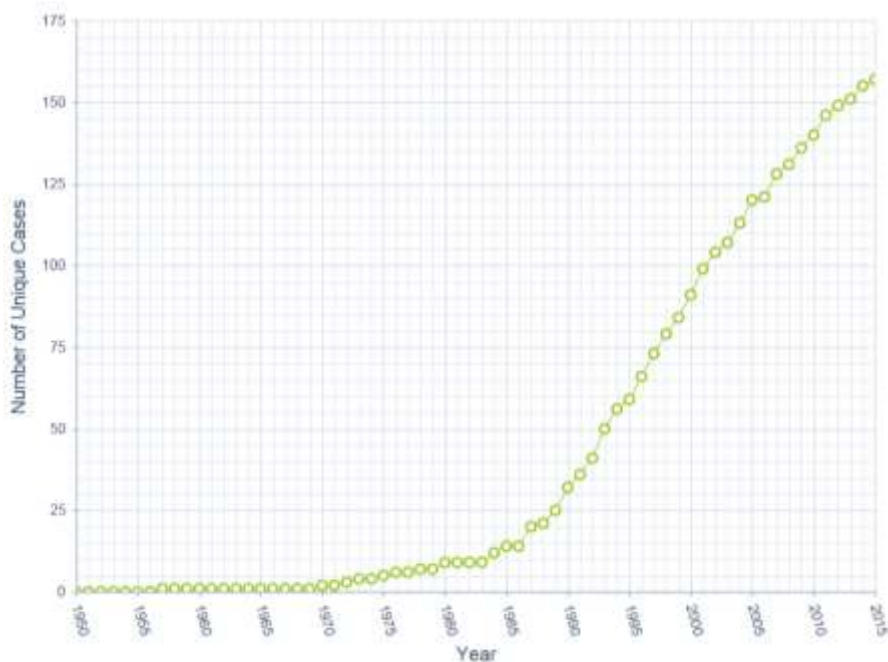
Dispersed in animal feed (e.g., herbicide-resistant palmer amaranth in cotton seed for feed introduced to Michigan)

<http://www.sugarproducer.com/2013/03/fighting-super-weeds>

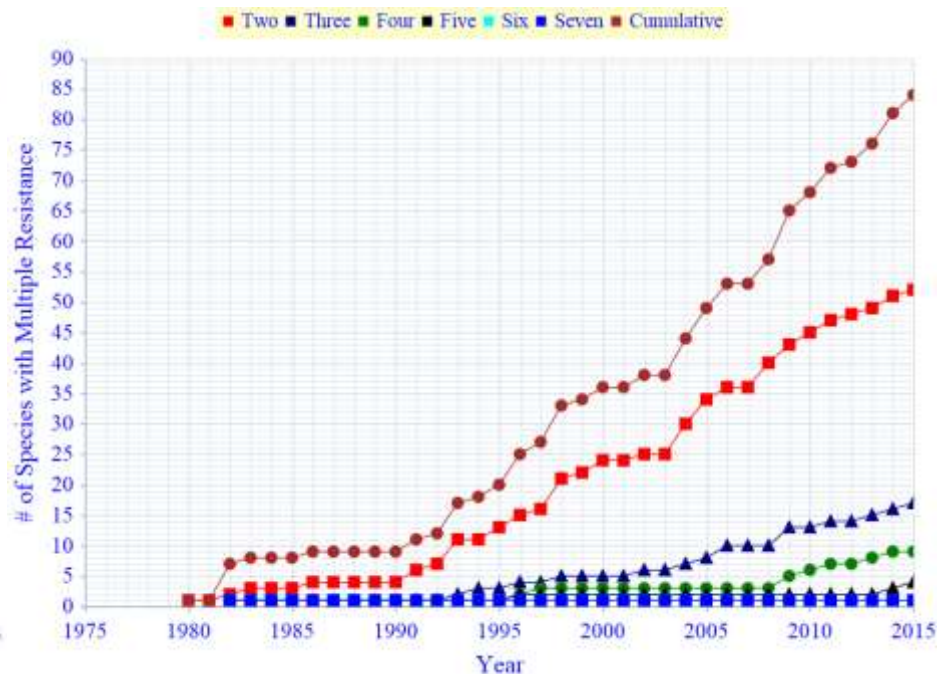


Herbicide Resistance in Weeds

Cumulative incidence of unique cases of herbicide resistance



Weed populations resistant to multiple modes herbicides



Herbicide Resistance in Weeds

APHIS – Biotechnology
Regulatory Services is working
with EPA

Weed Science Society of America
2014 Summit on Herbicide
Resistance

**What approaches do and could
NPPO countries use to address
this issue?**



Biofuels / Biomass / Bioenergy

Traits of an ideal bioenergy plant = traits associated with weeds & invasive plants

- Fast growth, high seed production, tolerant of repeated harvesting
- Breeders are selecting cultivars with these traits

NPPOs regulate plants as pests

Other govt. agencies are promoting the use of bioenergy plants



Potential risk of planting species at massive scales is very high



What role do NPPOs have in supporting the safe development and cultivation of biofuel plant species?



Evaluating Cultivars of Invasive Species

- Horticultural trade has introduced and promoted many of the plant species invading natural areas. (Mack, 1993)



Chinese Wisteria



Bradford Pear

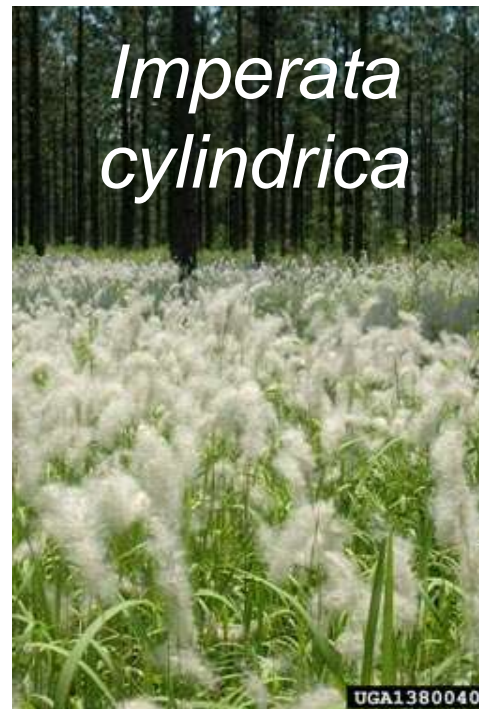


Mahonia

Evaluating Cultivars of Invasive Species

- Breeders are developing non-invasive cultivars of some popular invasive ornamentals.
- Inv. Plant Groups vs. Industry
- We need tools to evaluate the risk of these cultivars and the stability of these bred traits

How do NPPOs address these less invasive horticultural cultivars when assessing potential weediness? Does NAPPO have a potential role here?



Questions & Discussion



Questions & Discussion

- 1. Problem: Prioritizing 22,000 weeds for exclusion.** Should Mexico, Canada, and the United States take a regional approach to assess these species to determine which ones pose a significant risk and should be excluded?
- 2. Problem: Plant hybrids and polyploids.** How or should hybrids of already regulated noxious weeds be addressed?
- 3. Problem: Proliferation of weed lists.** As NPPOs, what kind of guidance can we provide here?
- 4. Problem: Herbicide resistance in agricultural weeds.** What approaches do and could NPPO member countries use to address this issue?
- 5. Problem: Potentially invasive biofuel species.** What role do NPPOs have in supporting the safe development and cultivation of biofuel plant species?
- 6. Problem: Dealing with less invasive cultivars of invasive species.** How do NPPOs address these less invasive horticultural cultivars when assessing potential weediness? Does NAPPO have a potential role here?

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