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Apple IPM Intensive Workshop

Weed Control in Apple Orchards

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Weeds in Orchard Systems

- Competition for water, light, nutrients
  - *New plantings*
  - *Dwarf rootstocks with shallow root systems in high density arrangements*
- Large vegetation can impact the deposition of crop protection chemicals
  - *Facilitate potential for herbicide drift and crop injury*
- Habitat for invertebrate and vertebrate pests
- Alter crop microclimates to influence disease development
- Interference with harvest operations

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Take home messages…

Start clean (first two years) and start early (May and June) with weed control

NY Fruit Quarterly 2013 Vol. 21:13-18

New Findings in Weed Control in Young Apple Orchards

Deborah Breth and Elizabeth Tee
Cornell Cooperative Extension, Lake Ontario Fruit Program
Albion, NY

Weed control is critical to early tree growth and profitability in new apple orchards planted with 1000-2000 trees per acre. Previous research on ground cover management and critical timing of weed control in orchards by Ian Merwin, et.al, (1999) was done in semi-dwarf orchards with 230 trees per acre. This project set out to look at how much impact weed control (or lack thereof) had on new high-density apple plantings and to evaluate herbicide programs. The project was funded by NESARE with a

"New high-density orchards depend on good tree growth in the first 2 years to develop the canopy for high crops in years 2-5. Our research shows that poor weed control in the first 2 years can result in less tree growth that is estimated to reduce production in the third year by half and a several year delay in breakeven payment of the initial investment. We estimate this important management practice in new orchards is worth thousands of dollars in long term profitability."

20-30% weed cover, they were treated again with the prescribed post-emergent herbicide (paraquat, glyphosate, or Rely). The weeds present in the plots for each date of evaluation were identified and recorded. The data was analyzed using ANOVA with mean separation by Tukey HSD using a P value of 0.05.

The number of days the residual treatments were effective before additional post-emergent control was necessary was calculated, and the number of additional post-emergence applications was used for economic analysis.

Tree trunk diameters were measured at 30 cm above the graft union using a caliper, and we calculated the trunk cross-sectional area (TCSA) in cm^2. Based on crop load management research done by Robinson, et al. (2009), we calculated the potential crop production after 1 and 2 years of different herbicide programs and determined the potential difference in profitability with "good weed control" vs. the untreated control plots. The data were incorporated into the "Net Present Value Excel Workbook" constructed by Alison DeMarree, Lake Ontario Fruit Program of Cornell Cooperative Extension, to look at economic impact of weed control in high density orchards. We also examined the trunks of the trees looking for any bark damage visible in Spring of 2013.

Soil samples were collected and tested under the Cornell Soil

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Critical Weed Control Requirements in High Density Apple Orchards

Deborah Breth
Cornell Cooperative Extension, Lake Ontario Fruit Program
Albion, NY

This research was supported by the New York Apple Research and Development Program

Weed control is a necessary component of high-density apple production systems to prevent competition for nutrients and water, and remove habitat for voles. Previous work done by Ian Merwin (1994)resulted in the current recommendation to maintain a weed-free strip under trees during the critical period of May through July to get optimal tree growth. This work was done on semi-dwarfing

"Our work shows that good weed control is a necessary component in new high-density orchards to maximize growth and early cropping. If weeds are allowed to establish in the early part of the growing season, we showed a significant growth reduction and a reduced cropping potential in the 2nd year worth $440-$1,188 per acre."

Figure 2. RR test site, Wayne Co., NY using Gala trees on M.9 rootstock planted May 3, 2014.

(Figure 1). A third site was established

TRT	Apr	May	Jun	Jul	Aug	Sep

Weed Size and Herbicide Injury to Trees

As weeds get taller, spray boom comes up and more opportunity to have herbicides contact foliage…

As a side note…Be sure you aren't applying an herbicide to your canopy

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Weed Control – Herbicides

- Activity
  - *Contact vs. systemic (translocated)*
- Selectivity
  - *Broadleaf specific vs. grass specific vs. non-selective*
- Timing (relative to weed emergence)
  - *Before (soil-applied, residual) vs. after (foliar applied) weed emergence*
- Timing (relative to crop age)
  - *Establishment phase vs. mature tree*
- Timing (relative to crop stage)
  - *In-season vs. dormant applications*

GRAMOXONE
Kerb® SC HERBICIDE
Sinbar® Agricultural Herbicide
Alion®
Roundup®
Rely® 280

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Pre-emergence (soil-applied)		
Active ingredient	Primary selectivity	Min. tree age
dichlobenil	AG, PG ABL, PBL	Depends on form/rate
diuron	AG, ABL	1 yr
flumioxazin	AG, ABL	Depends on protect.
halosulfuron	ABL, nutsedge	1 yr
indaziflam*Res Use	AG, ABL	3 yr
norflurazon	AG, nutsedge	none
oryzalin	AG	none

Pre-emergence (soil-applied)		
Active ingredient	Primary selectivity	Min. tree age
oxyfluorfen	ABL	1 yr
pendimethalin	AG	none
pronamide*Res Use	AG, PG	0.5-1 yr
rimsulfuron	AG, ABL	1 yr
simazine*Res Use	ABL	1 yr
terbacil*Res Use	AG, ABL	Depends on rate/NB

AG, ABL – annual grasses and broadleaves
PG, PBL – Perennial grasses and broadleaves

Always read the label before using products. Not all a.i.s are suitable for all rootstocks or labeled for use in all NY counties

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Post-emergence (foliar-applied)		
Active ingredient	Primary selectivity	Min. tree age
2,4-D*Res Use	ABL, PBL	1 yr
carfentrazone	ABL	none
clopyralid*Res Use	ABL, PBL	1 yr
glufosinate	AG, ABL	none
glyphosate	AG, ABL, PB, PBL	none

Post-emergence (foliar-applied)		
Active ingredient	Primary selectivity	Min. tree age
paraquat*Res Use	AG, ABL	1 yr
pyraflufen	ABL	none
saflufenacil*Res Use	ABL	1 yr
sethoxydim	AG, PG	none

AG, ABL – annual grasses and broadleaves, PG, PBL – Perennial grasses and broadleaves

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Glyphosate

- Roundup
- EPSPS synthase inhibitor
- Very good translocation
- Coverage – less critical
- Non-selective
- Good perennial “control”
- Good annual BL weeds
- Good annual grass control

Glufosinate

- Rely
- Glutamine synthase inhibitor
- Limited translocation
- Coverage – critical
- Non-selective
- Poor perennial “control”
- Good annual BL weeds (small)
- Variable annual grass control (small)

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Growth – inhibiting herbicides

WSSA Group	Details (mode of action, active ingredient, timing of application relative to weed emergence)
WSSA 1	ACCase inhibitor, prevents fatty acid synthesis/membrane development, sethoxydim, *POST*
WSSA 2	ALS inhibitor, inhibits branch chain amino acid/protein synthesis, halosulfuron, rimsulfuron, *PRE (POST)*
WSSA 3	Microtubule inhibitor, inhibits cell division, oryzalin, pendimethalin, pronamide, *PRE*
WSSA 4	Synthetic auxins, growth regulators, 2,4-D, clopyralid, *POST*
WSSA 9	EPSPS inhibitor, inhibits aromatic amino acid/protein synthesis, glyphosate, *POST*
WSSA 20, 29	Cellulose inhibitors, inhibits cell wall biosynthesis, dichlobenil, indaziflam, *PRE*

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Tissue – destroying herbicides

WSSA Group	Details (mode of action, active ingredient, timing of application relative to weed emergence)
WSSA 5, 7	PSII inhibitors, generates reactive molecules, diuron, simazine, terbacil, *PRE*
WSSA 10	Glutamine synthase inhibitor, ammonia buildup, glufosinate, *POST*
WSSA 12	Carotenoid biosynthesis inhibitor, generates reactive molecules, norflurazon, *PRE*
WSSA 14	PPO inhibitors, generates reactive molecules, flumioxazin, oxyfluorfen, *PRE (POST),* pyraflufen, saflufenacil, *POST*
WSSA 22	PS I electron diverter, generates reactive molecules, paraquat, *POST*

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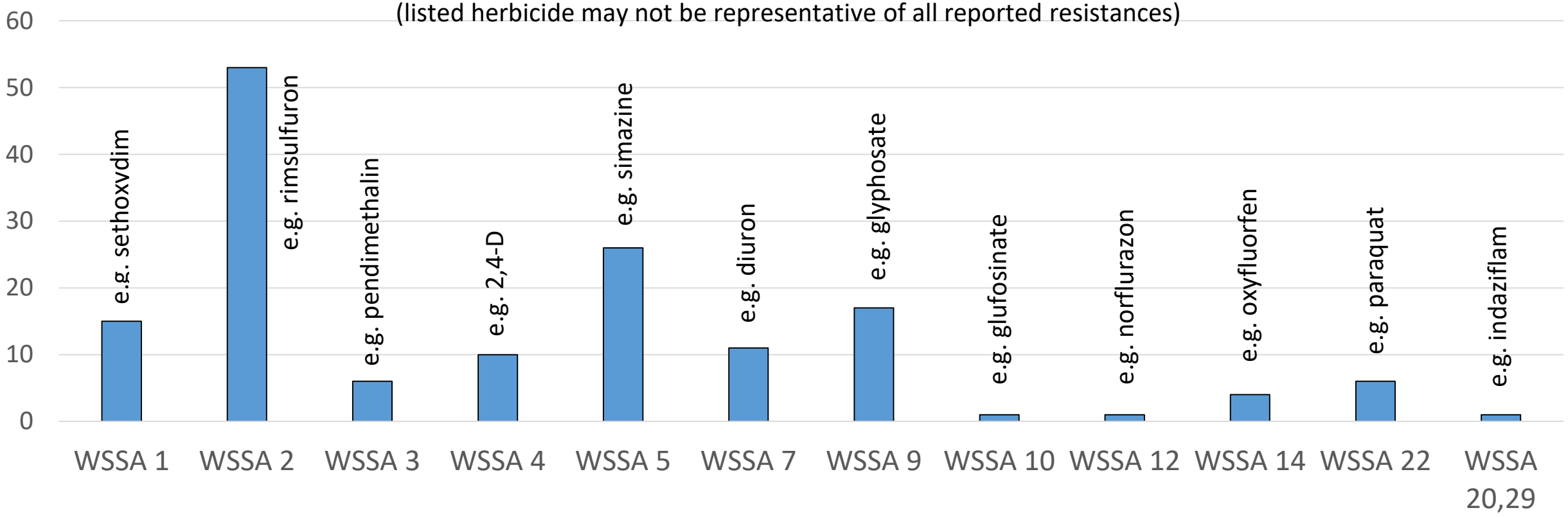
Resistant Weeds in US by WSSA Groups listed for Apples in NY

(listed herbicide may not be representative of all reported resistances)



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- Herbicide resistance that has likely developed in trees and vine systems

- 144 confirmed cases worldwide
- 24 confirmed cases in the US (CA, MI, NM, OR, WA)
  - *Glyphosate – 13*
  - *PSII inhibitors – 8*
  - *PSI diverters, ACCase inhibitors, ALS inhibitors, glufosinate – 2 or fewer*

  - Palmer and Powell amaranths, Italian and rigid ryegrass, Eastern black nightshade, velvetleaf, ladysthumb, hairy fleabane, horseweed, common lambsquarters

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- Perennial weeds in orchards
- *Convolvulus arvensis – Field bindweed*
- *Cyperus esculentus – yellow nutsedge*

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- Field Bindweed – *Convolvulus arvensis*
- Broadleaf, perennial vine
- Extensive root system (taproots to 30’)
- Spreading, regenerative rhizomes
- Prostrate vines that become climbing
- Flowering occurs summer until frost
- Seed production up to millions/A
- Seed are long-lived in soil (decades)

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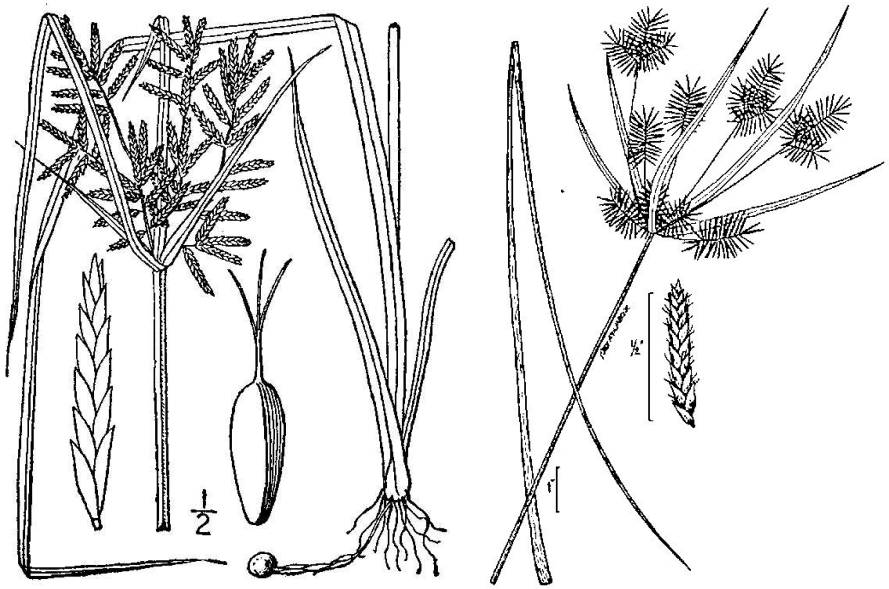
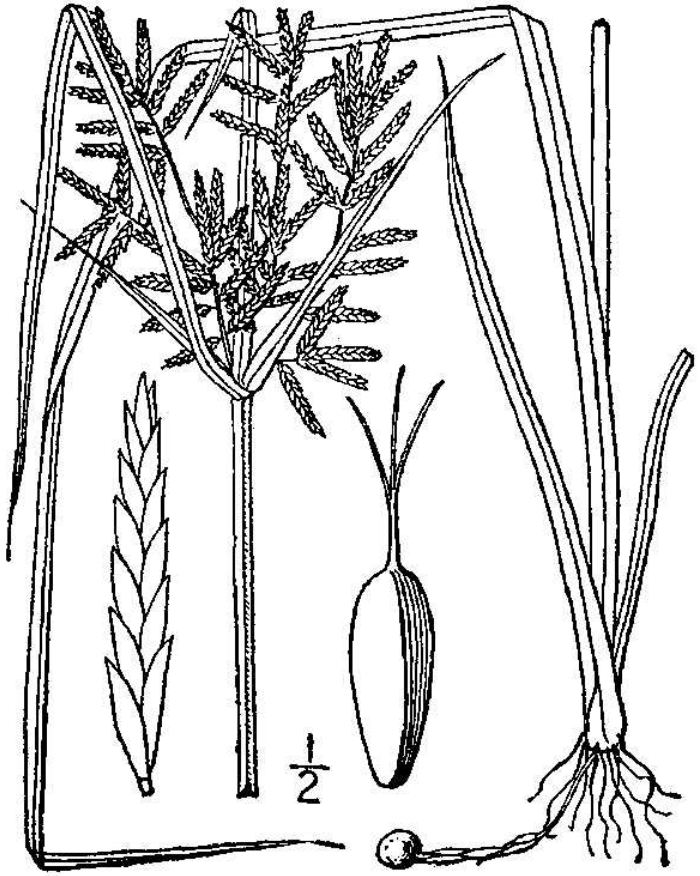
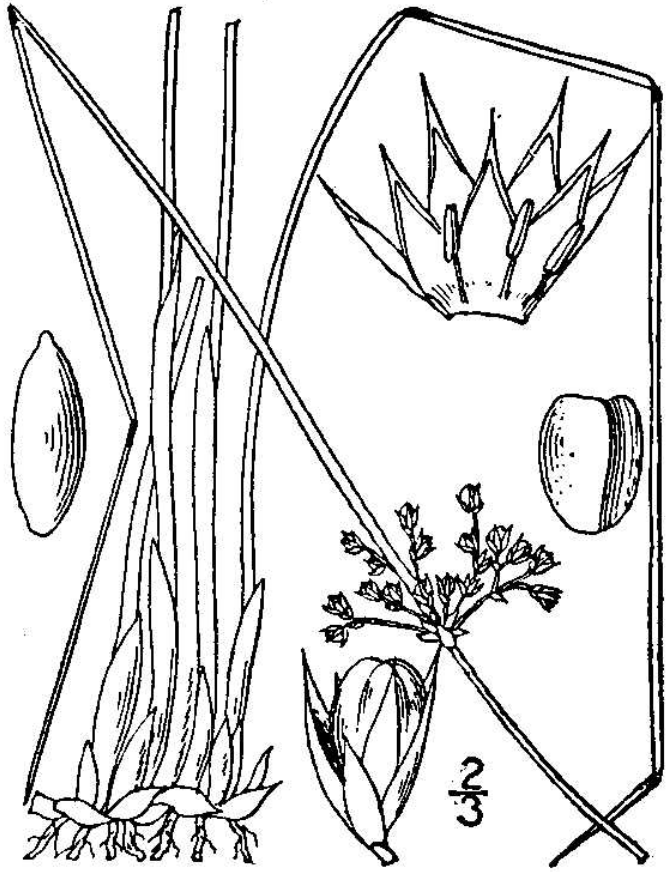
- Yellow nutsedge – *Cyperus esculentus*
- Grass-like perennial
- Stiff leaves, V-shaped in cross section
- Pointed at tip
- Yellow-gold flowers in clusters
- Seed are small and football-shaped
- Tubers (nutlets) produced singly on rhizomes
- Tubers persist for 3-5 years in the soil





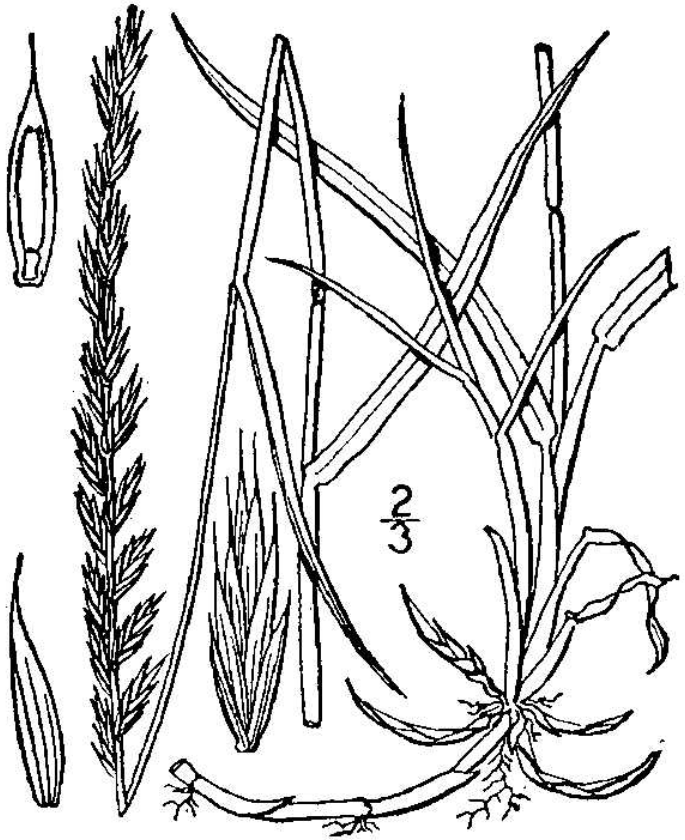
Sedges have edges

Cyperus esculentus



Rushes are round

Juncus effusus



Grasses have nodes from tips to the ground

Elymus repens

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Perennial Weed Control

- Bindweed
- Eradicate before planting
- Prevent establishment
- Frequent (2-3 wk) cultivation
- Shading

- Nutsedge
- Eradicate before planting
- Prevent establishment
- Eliminate wet conditions
- Shading

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Perennial Weed Control

- Bindweed
- Dichlobenil
- Rimsulfuron (PRE?)
- Glyphosate
- Auxinic herbicides

- Nutsedge
- Dichlobenil
- Rimsulfuron (PRE, EPOST)
- Halosulfuron (PRE, EPOST)
- Glyphosate

- Dichlobenil
  - Volatilizes quickly at warmer temperatures (apply late fall or early spring)
  - Higher rates needed for perennials

- Rimsulfuron, halosulfuron
  - Rimsulfuron PRE for field bindweed in California, POST not effective
  - Halosulfuron PRE or POST (3-5 leaf) for nutsedge

- Glyphosate
  - Flowering bindweed
  - 3-5 leaf nutsedge
  - Do not let come into contact with foliage, green bark

- Auxinic
  - Timing with respect to bloom, avoid contact with sensitive tree tissue
  - Broadleaf selective
  - Clopyralid not available on long Island

What do you want to learn more about with respect to weeds and weed control (please rank)

Herbicides and modes of action

Timing of herbicides to maximize control

How to manage perennial species

Diagnosing herbicide injury in trees

Herbicide resistance detection and management

Herbicide impacts on soil health

Adjuvant impact on herbicide efficacy

Non-chemical/organic weed control

Climate change impacts on weeds/weed control

Were there any topics of interest in that you want more information about that WERE NOT mentioned in the previous slide?