Liverwort Control in Nurseries

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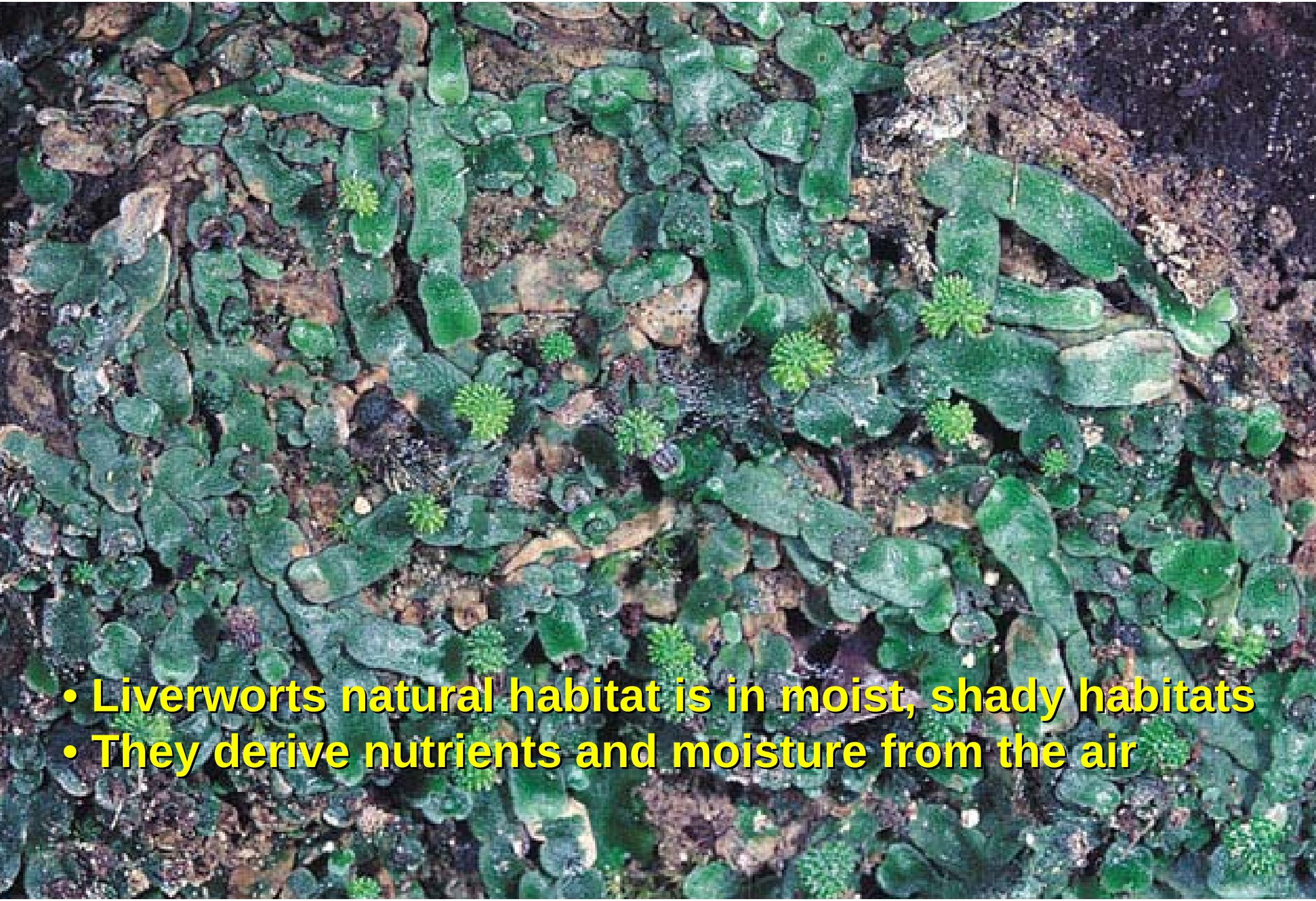

• Liverworts natural habitat is in moist, shady habitats
• They derive nutrients and moisture from the air

Liverwort Biology

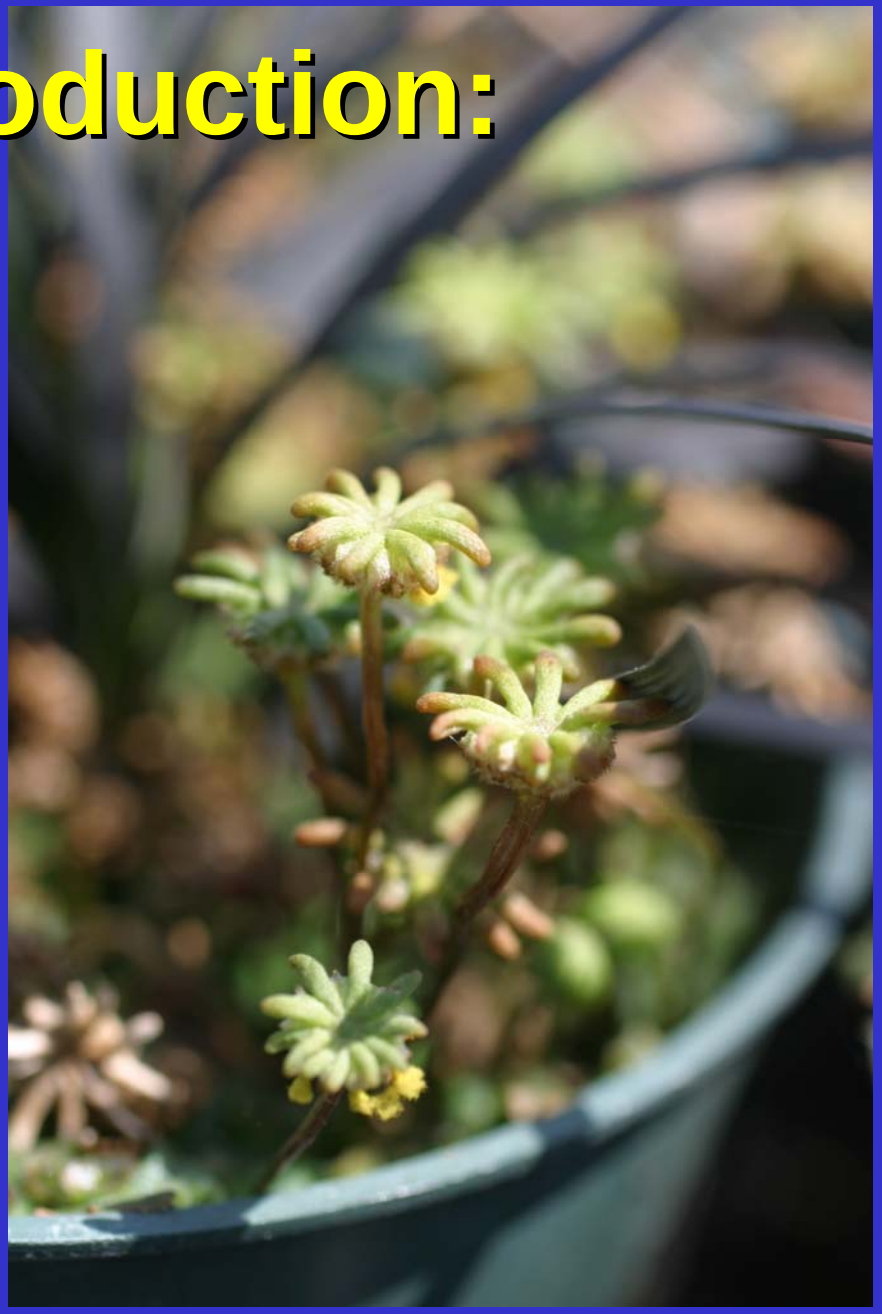
They are composed of a flat, branching thallus (gametophyte). Rhizoids attach the thallus to the soil. It reproduces either vegetatively or by spores

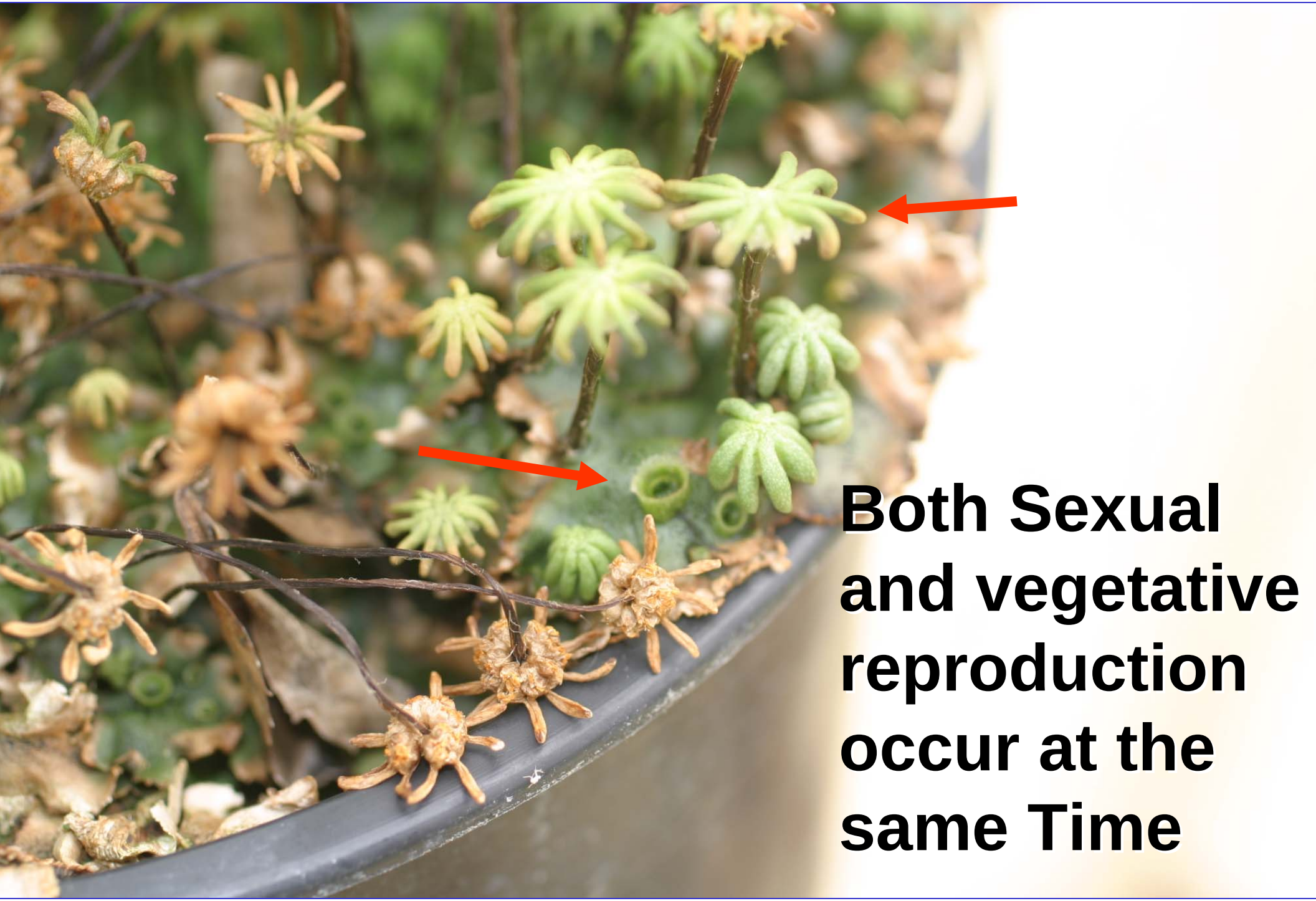
Vegetative Reproduction

Vegetative reproduction: Fragmentation and forking of old plants.
Gametophytes produce gemma cups.
Gemmae inside the cups splash out of the cups and can germinate to make young plants.

Sexual Reproduction:

The male and female structures (sporophytes). Spores are produced by fertilization and are airborne.





Both Sexual and vegetative reproduction occur at the same Time


3W

Issues with Liverworts in Containers

- Increase weeding costs
- Reduce appeal of plants and buyers may not accept infested containers
- Heavy infestations causes irrigation water (and fertilizers) to umbrella off containers
- Liverworts can use significant amounts of N and water for their growth
- Cause potting mix losses (by weeding)

Cultural Control Strategies

1. Sanitation – Reduce vegetative propagules and spores by controlling liverworts in and around the production area.
2. Water management – Maintaining the surface of the media as dry as possible (watering in the morning).
3. Substrate - Use a “loose” growing substrate that drains and dries at the surface quickly.
4. Mulch - Materials that provide shade & dry fast.
5. Indirect controls - Some fungicides and metals may provide some control (Kocide, Mancozeb Thiram and Captan)

Chemical Control

- Preemergent herbicides:
  - oxadiazon (Ronstar, Regal 0-0)
  - oryzalin (Surflan, Rout)
  - flumioxazin (Broadstar)*
- Sanitation type materials
  - Safers DeMoss

* liverworts on the label

2004 Preemergence Liverwort Control Trial

Materials	Active	Rate
Broadstar 0.25% G	Flumioxazin	24.3 lbs/A
Broadstar 0.25% G	Flumioxazin	49.6 lbs/A
Broadstar 0.25% G	Flumioxazin	99.2 lbs/A
Apex Slow release Iron	Ferrous sulfate (29% Fe)	4 lbs/100 ft^2
Apex Slow release Iron	Ferrous sulfate (29% Fe)	1 lb/100 ft^2
Lilly Miller Iron	Ferrous sulfate (30% Fe)	1 lb/100 ft^2
Lilly Miller Iron	Ferrous sulfate (30% Fe)	0.5 lb + 0.5 lb/100 ft^2
Nordox Copper	Copper 75 WG (Cuprous oxide)	0.33 lb/1000 ft^2
Phyton Copper	Copper 27 (Copper sulfate pentahydrate)	6.5 fl. oz/10 gal
OH2	Oxyfluorfen (2%) + Pendimethalin (1%)	2.3 lb product/1000 ft^2
Untreated	----	----

Preemergence Rating Scale

Score	% Cover
0	0
1	1-10
2	11-25
3	26-50
4	51-75
5	76-90
6	91-99
7	100

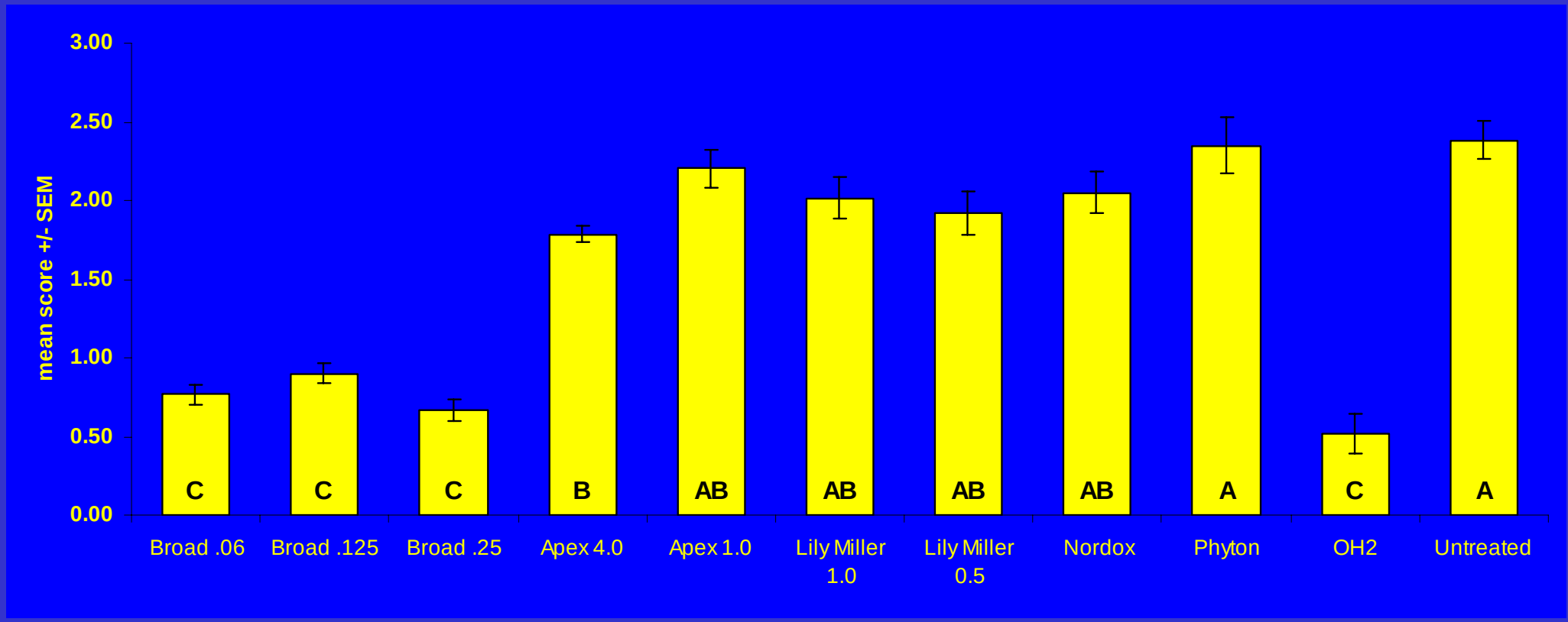
Apex Prills

(Even distribution?)

Young Liverwort

Liverwort Trial Evaluation

Summary of Two Ratings



2005 Postemergence Evaluation

Mogeton, Chemtura Crop Protection

Species Examined

- Helleborus orientalis
- Iris Douglasiana
- Liriope muscari
- Athyrium nipponicum var. Pictum
- Echinacea purpurea
- Heuchera sangunea
- Aster Chilensis
- Miscanthus sinensis
- Lavender angustifulia
- Achillea millefolium
- Agastache mexicana
- Aquilegia sp.
- Coreopsis auriculata

All treatments were applied in
the equivalent of 218 gallons of water per acre.
No adjuvant was applied with the treatments.

Treatments were : 1) untreated control;
2) 2 oz/gallon*; 3) 4 oz/gallon; and 4) 8 oz/gallon
applied at the rate of 2 quarts/100 ft2. Treatments
reapplied 4 weeks after first application.

Evaluations for phytotoxicity were made
at 1, 2, 4, 8 and 12 weeks following the
first application.

* 2 ounces will be the labeled rate

Liverwort Postemergence Control Trial

- **No Damage:**
- **Echinacea purpurea**
- **Heuchera sangunea**
- **Coreopsis auriculata**
- **Lavender angustifulia**
- **Achillea millefolium**

Heuchera sangunea

Liverwort Postemergence Control Trial

- Slight Damage:
- Helleborus orientalis
- Iris Douglasiana
- Agastache Mexicana
- Aster Chilensis

Some of these species had defects that was difficult to distinguish from treatment damage

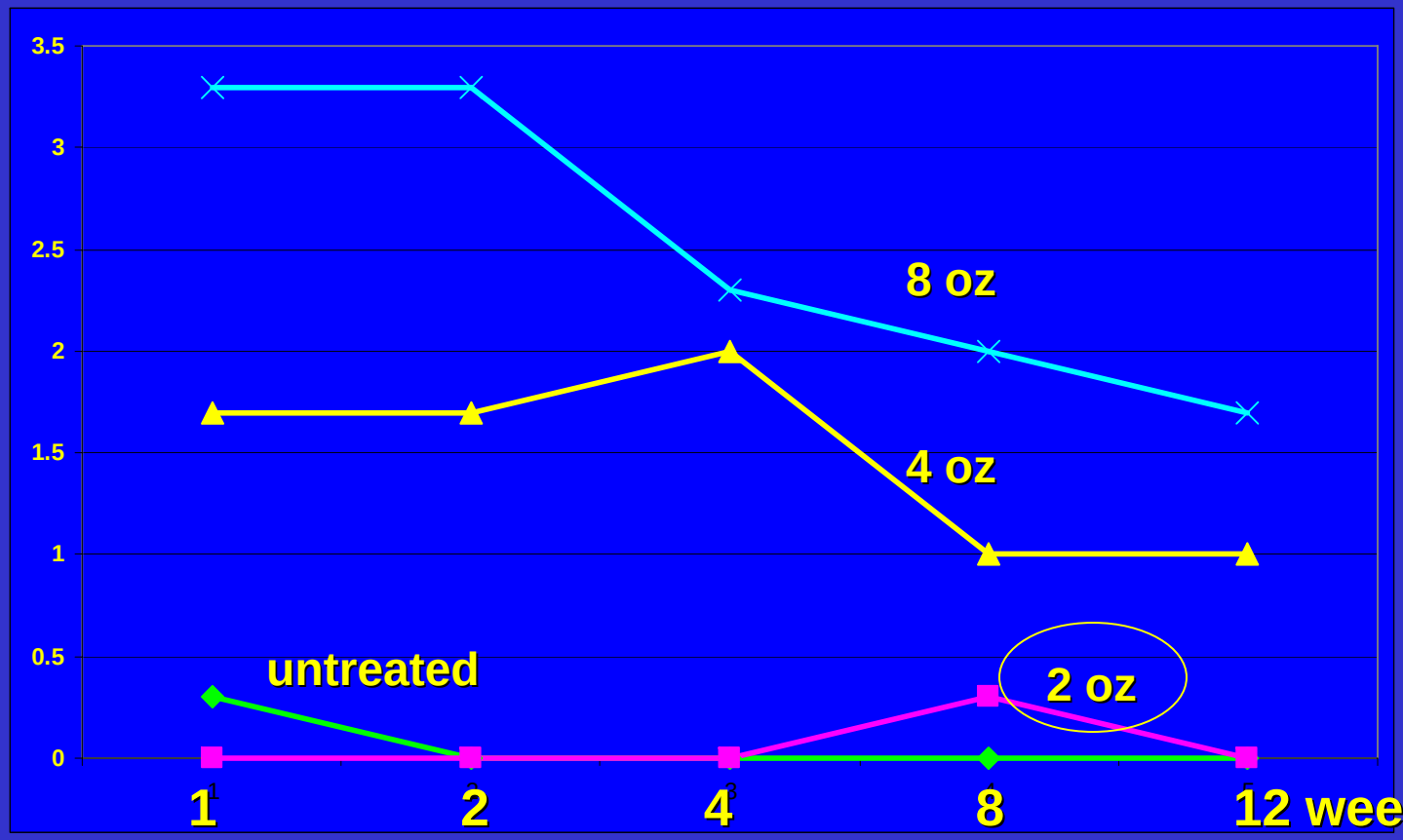
Liverwort Postemergence Control Trial

- Species with potential Issues:
- Miscanthus sinensis
- Aquilegia sp.
- Liriope muscari
- Athyrium nipponicum var. Pictum

Sensitive growing point and chlorosis

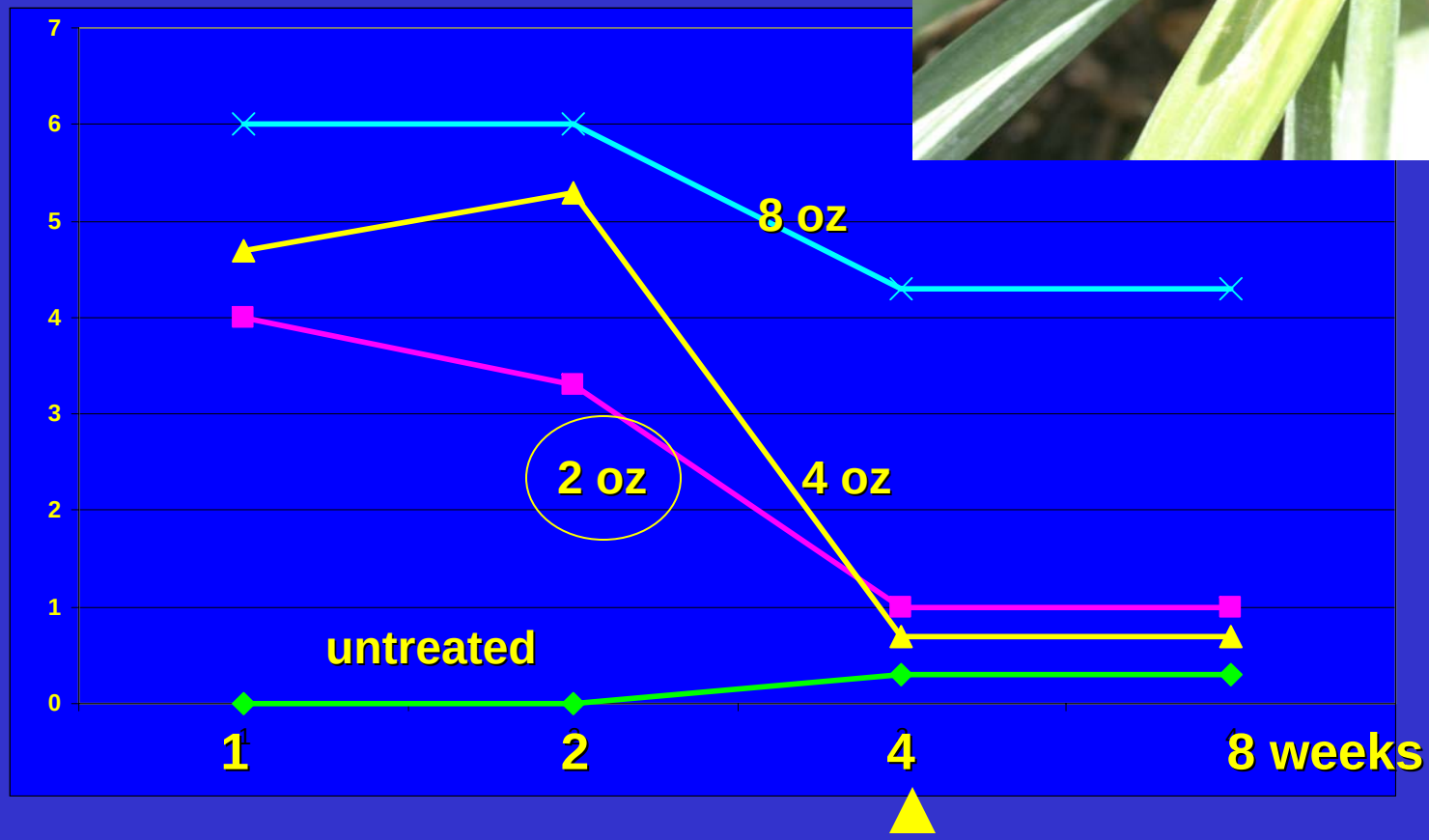
Miscanthus

Burn at the base of the leaf that rises higher in the foliage as the leaf expands



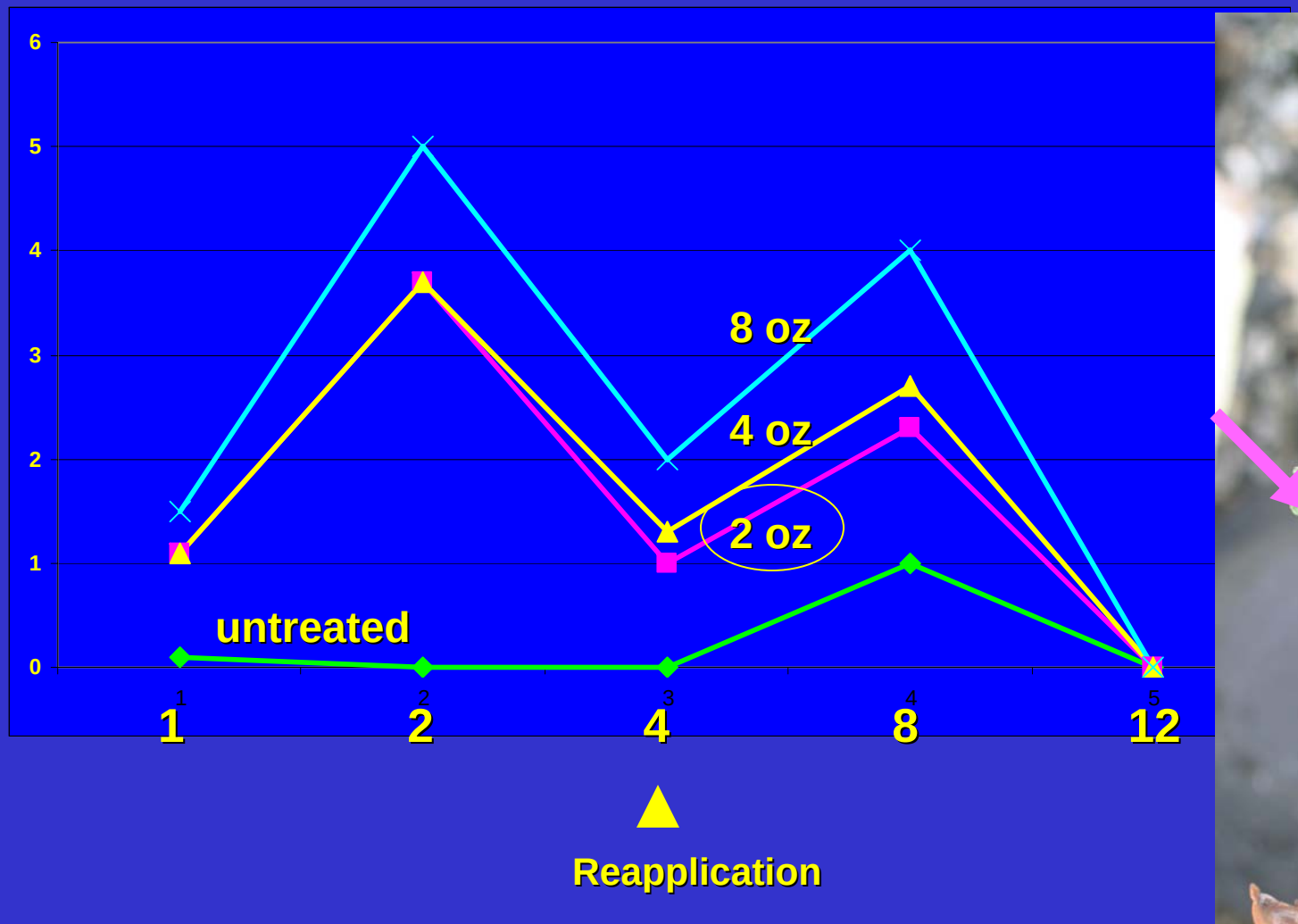
Liriope

Burn at the base of the leaf that rises higher in the foliage as the leaf expands

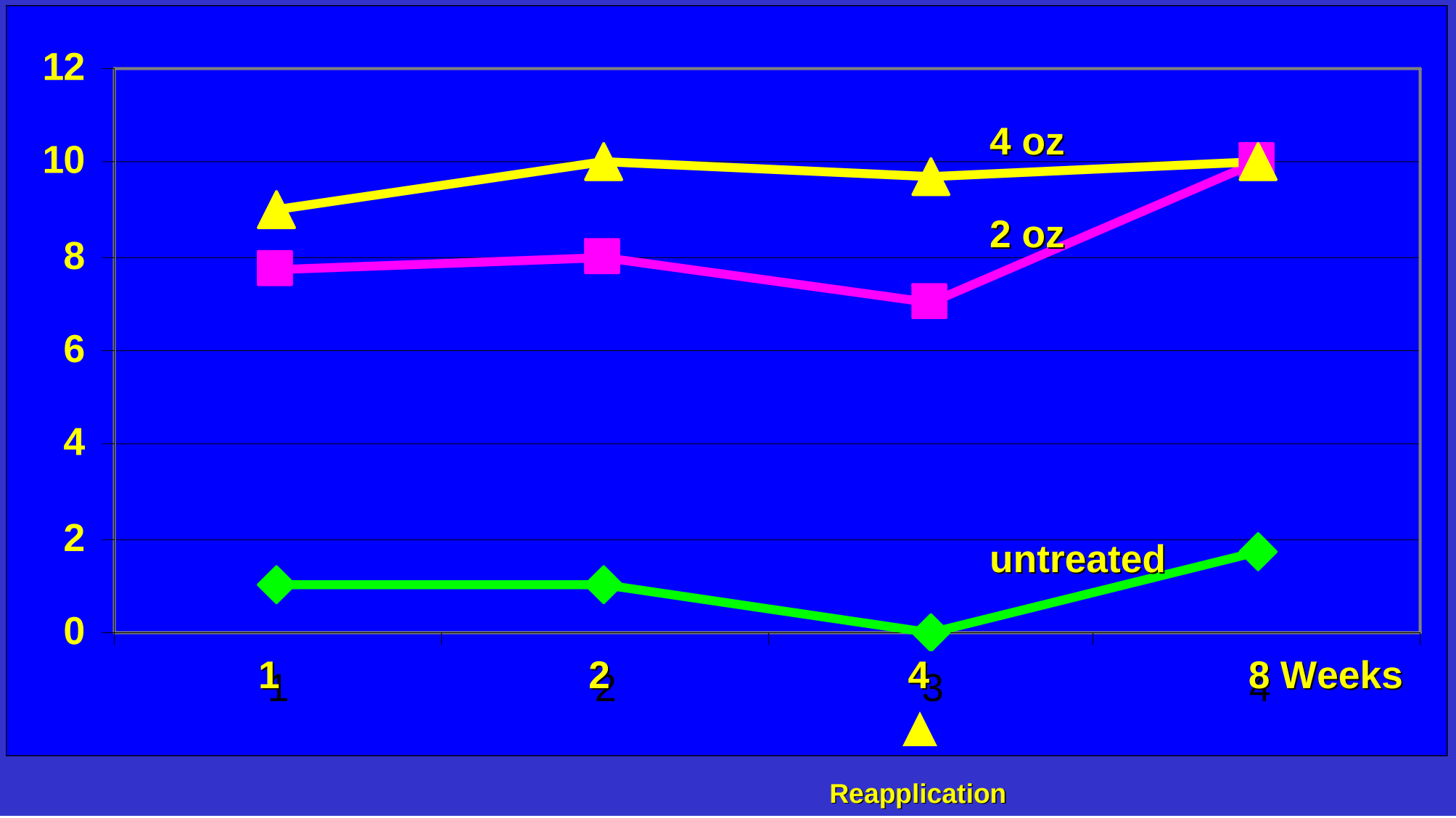


Columbine

Chlorosis and necrosis of the tips of the leaves



Liverwort Control



Pre Treatment

Post Treatment

Mogeton Summary

- Federal application to EPA will be submitted soon
- Will be able to apply for Section 18 after EPA review
- Will be available for use in greenhouses
- Will allow growers to clean up liverworts before moving pots outside where preemergence materials may then be used
- Initial injury on some species declines over time

Liverwort Control Summary

- Good sanitation is the first step to reduce the spore load in the nursery
- Managing water (timing, amount, drainage, ventilation)
- Preemergence herbicide provide good control
- Mogeton is a postemergence options that will provide an opportunity to selectively control infestations in containers on many important species

Acknowledgements

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