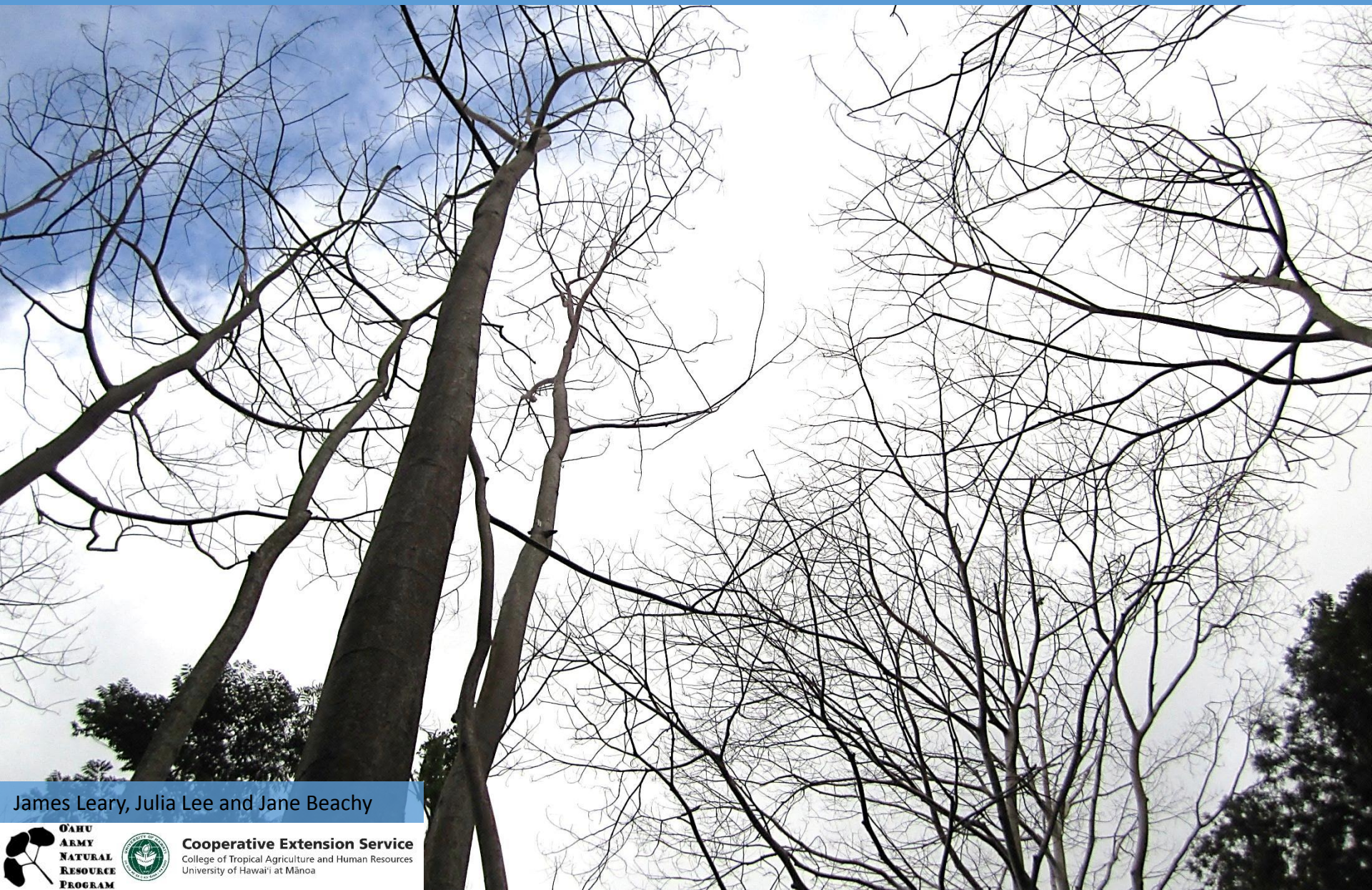


# Efficacy of Undiluted Herbicide Injections on Tropical Woody Species in Hawaii



James Leary, Julia Lee and Jane Beachy



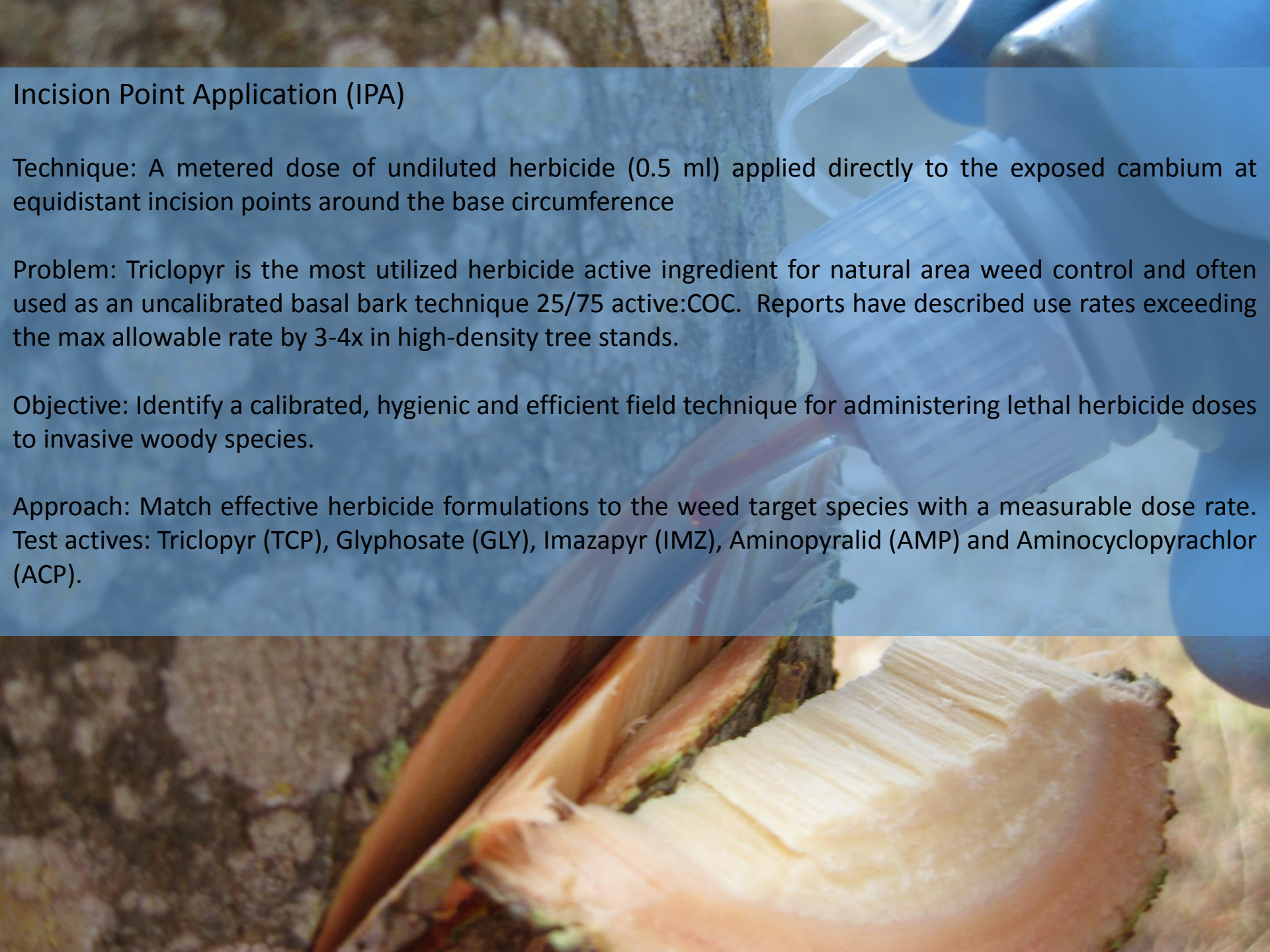
**Cooperative Extension Service**  
College of Tropical Agriculture and Human Resources  
University of Hawai'i at Mānoa



# Incision Point Application (IPA)





The background image is a composite. The top half shows a blue pipette with a white tip, positioned as if to dispense liquid. The bottom half shows a close-up of a tree trunk where a section of the bark has been removed, revealing the light-colored, fibrous cambium and the darker, textured inner wood. The text is overlaid on a semi-transparent blue rectangular area.

## Incision Point Application (IPA)

**Technique:** A metered dose of undiluted herbicide (0.5 ml) applied directly to the exposed cambium at equidistant incision points around the base circumference

**Problem:** Triclopyr is the most utilized herbicide active ingredient for natural area weed control and often used as an uncalibrated basal bark technique 25/75 active:COC. Reports have described use rates exceeding the max allowable rate by 3-4x in high-density tree stands.

**Objective:** Identify a calibrated, hygienic and efficient field technique for administering lethal herbicide doses to invasive woody species.

**Approach:** Match effective herbicide formulations to the weed target species with a measurable dose rate. Test actives: Triclopyr (TCP), Glyphosate (GLY), Imazapyr (IMZ), Aminopyralid (AMP) and Aminocyclopyrachlor (ACP).



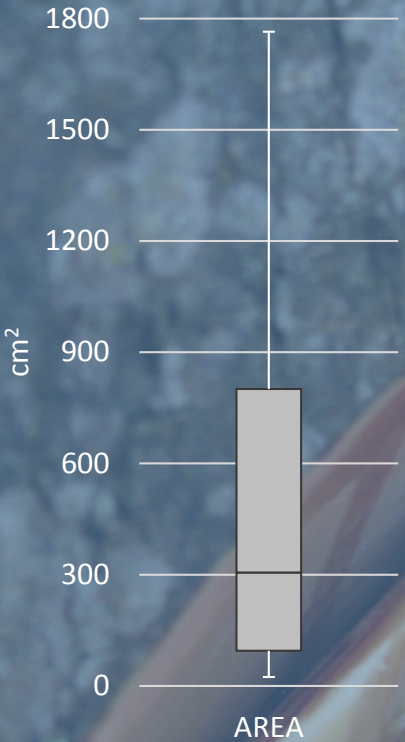
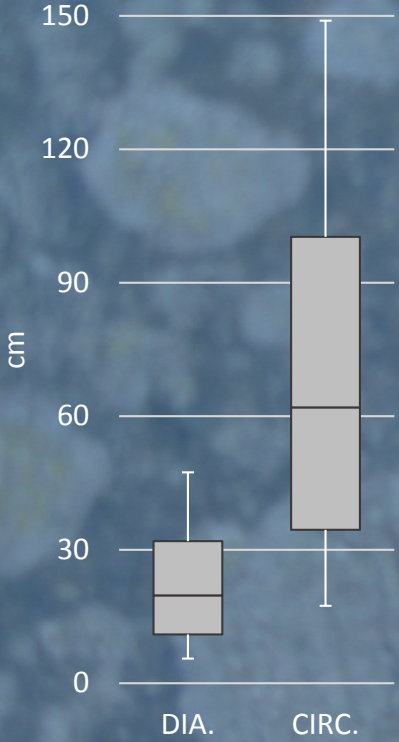
## Equipment and Resources



Hatchet/machete, Droppers (4 x 1 fl oz), Herbicide formulations, Tape measure (for circumference measurements), Aluminum tags and flagging, GPS, PPE: safety goggles and nitrile gloves



Methods: Application Dose (n=30 species; 35 experiments)



## Methods: Canopy defoliation ratings in the field

Visually subdivide leaf canopy into four equal quadrants and rank each quadrant 1–4 for level of defoliation for a total of four rank values for each tree unit

### Canopy defoliation rating system:

- 1- 100% defoliation (no intact leaves, unless fully necrotic and desiccated)
- 2- >50% defoliation (even if a single leaf is present in the canopy, up to 99% defoliation)
- 3- <50% defoliation (mostly intact canopy with observable defoliation and/or necrosis)
- 4- 0% defoliation (no observable defoliation)

No defoliation  
4,4,4,4



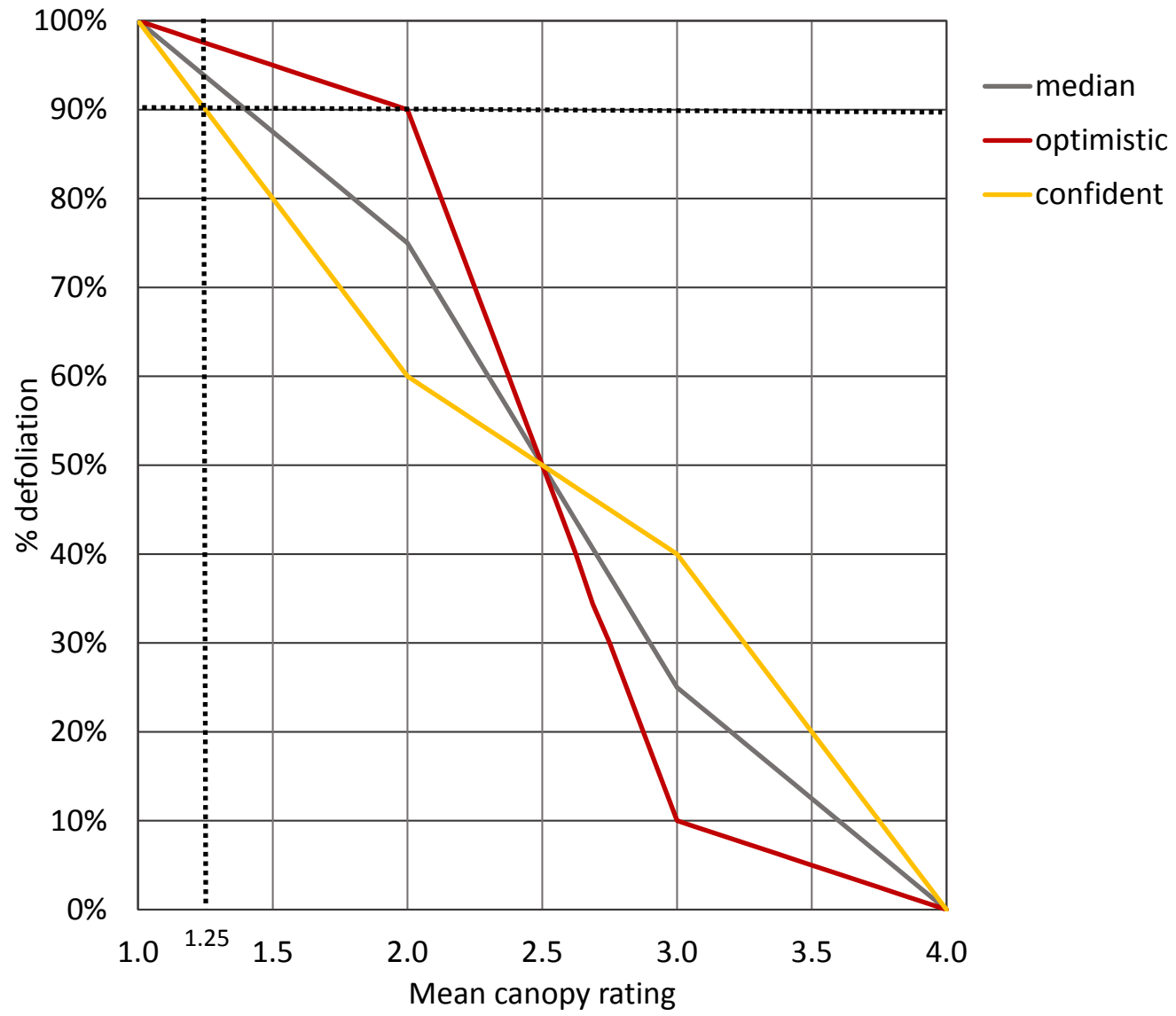
partial defoliation  
1,1,2,2



complete defoliation  
1,1,1,1

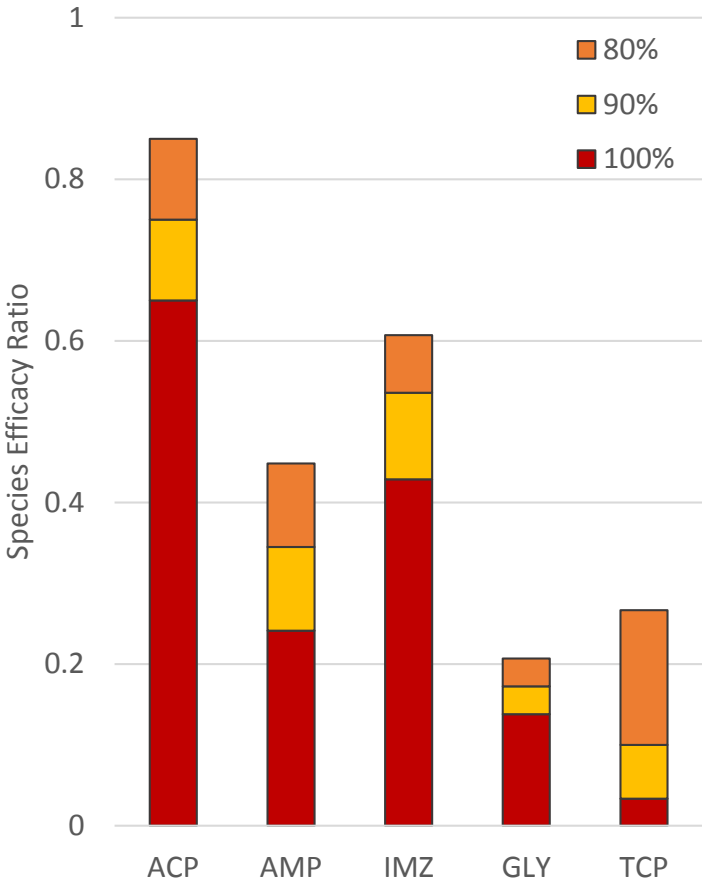


Methods: Conversion from canopy defoliation rating (x-axis) to percent defoliation (y-axis)





# Results: Herbicide Efficacy Across Species Spectrum

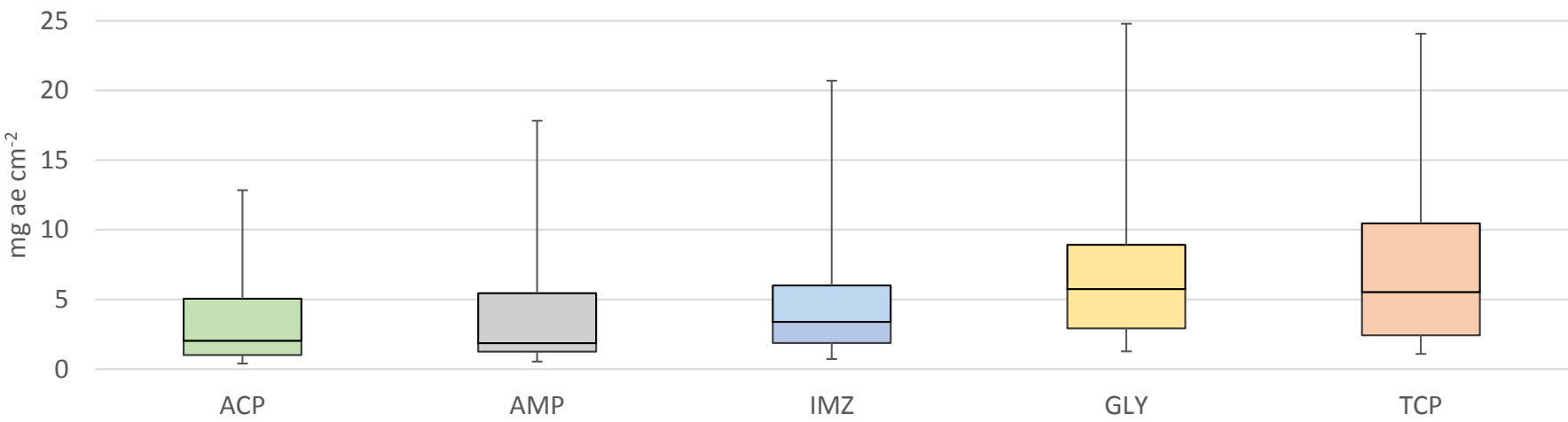


Sp. (n=30)	DAT	TCP	GLY	IMZ	AMP	ACP
<i>Acacia confusa</i>	904	45	45	45	80	100
<i>Aleurites moluccana</i>	301	3	7	93	73	
<i>Araucaria columellaris</i>	500	33	65	61	100	100
<i>Araucaria heterophylla</i>	215	9	50	46	56	
<i>Ardesia elliptica</i>	181	28	30	98	45	
<i>Casaurina equistifolia</i>	206	65	51	40	59	61
<i>Chrysophyllum oliviforme</i>	164	53	48	56	58	
<i>Cinnamomum burmannii</i>	478	58	95	95	74	100
<i>Citharexylum caudatum</i>	328	3	41	56	22	
<i>Coffea arabica</i>	478	39	93	80	91	100
<i>Cordia alliodora</i>	184	32	51	96	46	
<i>Corymbia citriodora</i>	338	0	0	0	0	
<i>Cryptomeria japonica</i>	431	34	22	32	43	
<i>Falcataria moluccana</i>	474	56	39	0	100	100
<i>Fraxinus uhdei</i>	698	58	55	100	39	77
<i>Grevillia robusta</i>	776	100	0	100	100	85
<i>Heliocarpus popawensis</i>	301	30	44	95	47	
<i>Lueceana luecocephala</i>	367	74	65	65	100	100
<i>Melaleuca quinqueveria</i>	150	41	61	84	75	
<i>Morella faya</i>	224	50	58	95	68	
<i>Pimenta dioica</i>	215	24	28	95	66	
<i>Pinus patchula</i>	696	73	100	61	33	80
<i>Psidium cattelinium</i>	648	85	74	59	100	100
<i>Schefflera actinifolia</i>	435	20	100	100	100	100
<i>Schinus terebinthifolius</i>	559	74	72	91	100	100
<i>Spathodea campanulata</i>	321	53	49	100	24	
<i>Syzigium cumuni</i>	657	37	35	72	58	100
<i>Toona ciliata</i>	904	100	54	100	65	100
<i>Trema orientalis</i>	206	73	57	93	98	

Results: ACP, AMP and IMZ were superior to GLY and TCP

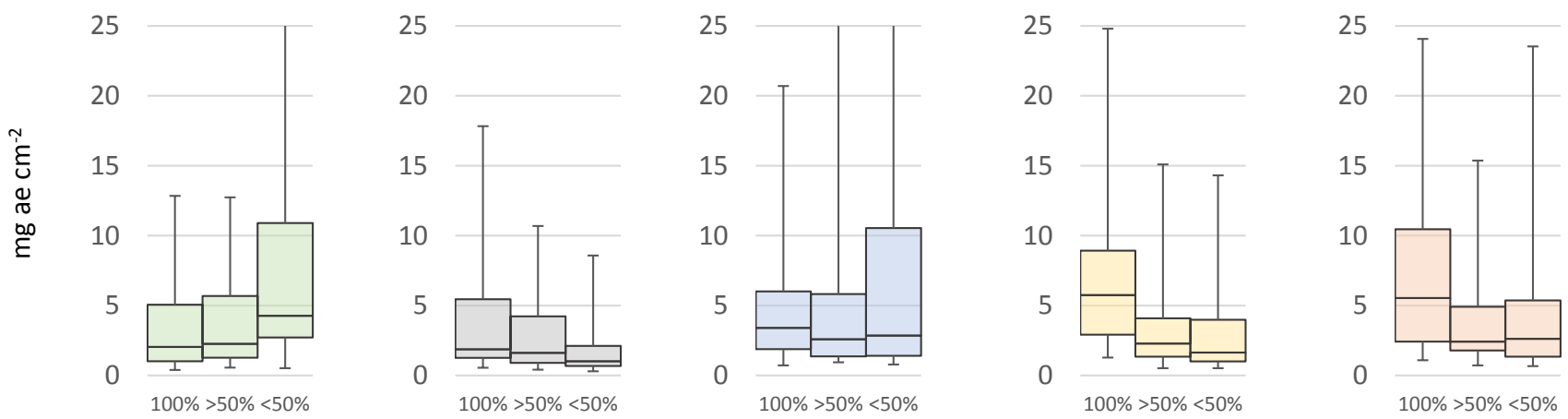


# Results: Effective Dose (100% defoliation)

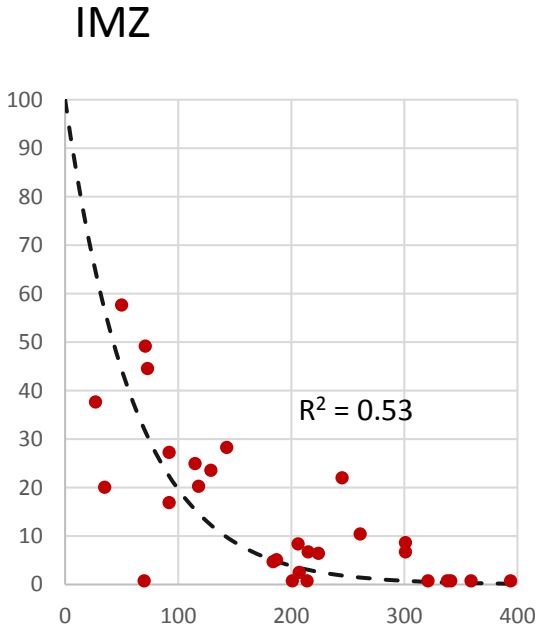
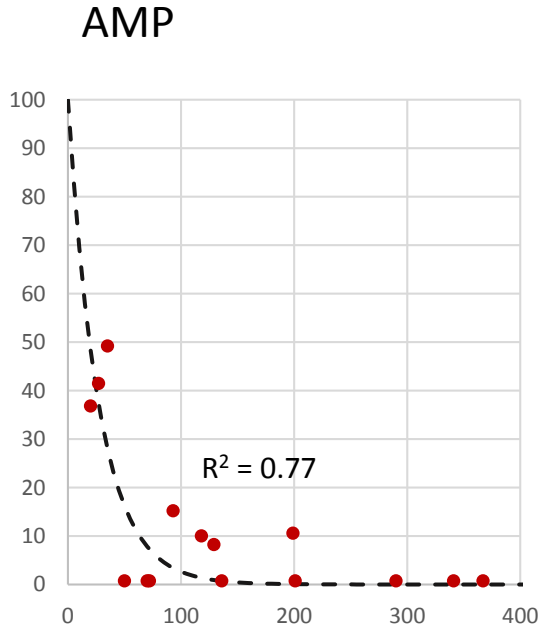
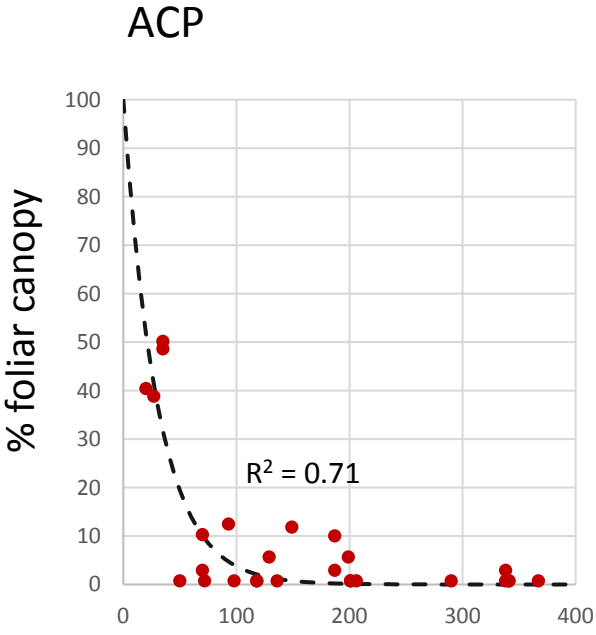


ACP, AMP and IMZ effective at <5 mg ae cm<sup>-2</sup>, GLY and TCP effective at >5 mg ae cm<sup>-2</sup>

Note dose response trend accentuated with GLY and TCP



# Results: Efficacy Timeline

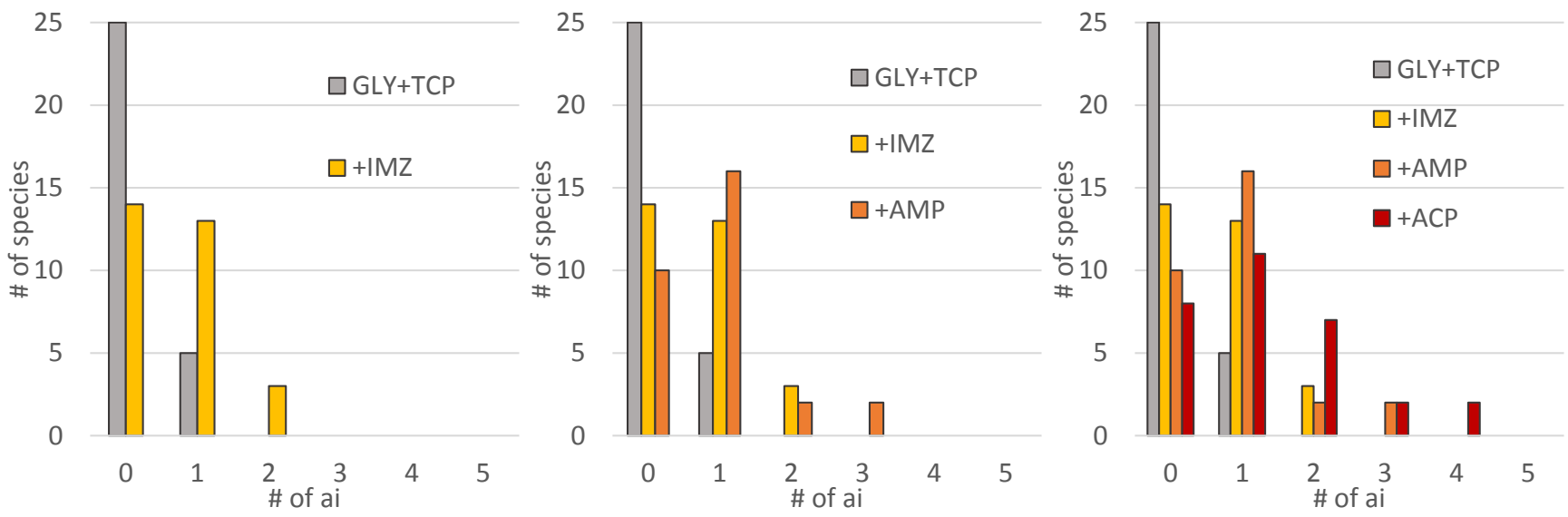


days after treatment

- Aminocyclopyrachlor (ACP; n=13), Aminopyralid (AMP; n=7) and Imazapyr (IMZ; n=14)
- Each plot fit with a single parameter exponential decay function  $y = 100e^{-xt}$ , where  $t$  = days after treatment (DAT).
- Notice for IMZ >100 DAT before 90% defoliation achieved, while <100 DAT for AMP and ACP.



# Results: Effective Herbicide Options



- Adoptions of IMZ, AMP and ACP greatly expands effective options
- Majority of species have one herbicide option superior to others
- Concerned up to seven species without an effective herbicide match

Nufarm

# Polaris<sup>®</sup> AC Complete

## Herbicide

For the control of undesirable vegetation in forestry sites, aquatic sites, grass pasture, rangeland, fence rows, for establishment and maintenance of wildlife openings, grass pastures and rangeland. Additionally for control of undesirable vegetation in dormant bermudagrass and bahiagrass, under certain paved areas, and industrial noncropland areas including railroad, utility, pipeline and highway rights-of-way, utility plant sites, petroleum tank farms, pumping installations, storage areas, building perimeters, irrigation and non-irrigation ditchbanks, roads, transmission lines, and industrial bare ground areas.

### ACTIVE INGREDIENT:

Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid)\* ..... 53.10%

**OTHER INGREDIENTS:** ..... 46.90%

**TOTAL:** ..... 100.00%

\*Equivalent to 43.3% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid or 4 pounds acid per gallon.

### CUT SURFACE APPLICATIONS WITH DILUTE AND CONCENTRATE SOLUTIONS

This product may be mixed as either a concentrated or dilute solution. The dilute solution may be used for applications to the cut surface of the stump or to cuts on the stem of the target woody vegetation. Concentrated solutions may be used for applications to cuts on the stem. Use of the concentrated solution permits application to fewer cuts on the stem, especially for large diameter trees. Follow the application instructions to determine proper application techniques for each type of solution.

- To prepare a dilute solution, mix 4 to 6 fluid ounces of this product with one gallon of water. The use of a surfactant or penetrating agent may improve uptake through partially callused cambiums.
- To prepare a concentrated solution, mix 1 quart of this product with no more than 1 quart of water.

#### Cut stump treatments:

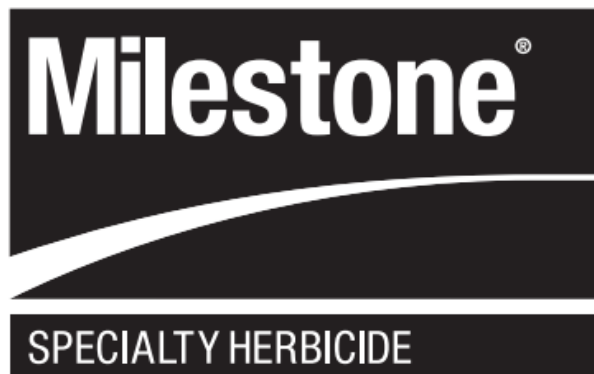
- Dilute Solution - Spray or brush the solution onto the cambium area of the freshly cut stump surface. Insure that the solution thoroughly wets the entire cambium area (the wood next to the bark of the stump).

#### Cut stem (injection, hack & squirt) treatments:

- Dilute Solutions - Using standard injection equipment, apply 1 milliliter of solution at each injection site around the tree with no more than one-inch intervals between cut edges. Insure that the injector completely penetrates the bark at each injection site.
- Concentrate Solutions - Using standard injection equipment, apply 1 milliliter of solution at each injection site. Make at least one injection cut for every 3 inches of Diameter at Breast Height (DBH) on the target tree. For example, a 3-inch DBH tree will receive 1 injection cut and a 6-inch DBH tree will receive 2 injection cuts. On trees requiring more than one injection site place the injection cuts at approximately equal intervals around the tree.



# Specimen Label



GROUP	4	HERBICIDE
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Active Ingredient:

Triisopropanolammonium salt of 2-pyridine carboxylic acid, 4-amino-3,6-dichloro-.....	40.6%
Other Ingredients .....	59.4%
Total .....	100.0%

Acid Equivalent: aminopyralid (2-pyridine carboxylic acid, 4-amino-3,6-dichloro-) - 21.1% - 2 lb/gal

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- For control of annual and perennial broadleaf weeds including invasive and noxious weeds, certain annual grasses, and certain woody plants and vines, on:
  - rangeland, permanent grass pastures (including grasses grown for hay\*), Conservation Reserve Program (CRP)
  - non-crop areas for example, airports, barrow ditches, communication transmission lines, electric power and utility rights-of-way, fencerows, gravel pits, industrial sites, military sites, mining and drilling areas, oil and gas pads, non-irrigation ditch banks, parking lots, petroleum tank farms, pipelines, roadsides, railroads, storage areas, dry storm water retention areas, substations, unimproved rough turf grasses; and
  - natural areas (open space) for example, campgrounds, parks, prairie management, trailheads and trails, recreation areas, wildlife openings, and wildlife habitat and management areas including seasonally dry flood plains, deltas, marshes, paire potholes, or vernal pools;
- including grazed areas in and around these sites.

## For use in Hawaii only:

### Incision Point Application (IPA) also known as Tree Injection or Hack and Squirt

For control of susceptible tree species such as Albezia, and other legumes and susceptible tree species, make cuts around the tree trunk at a convenient height with a machete, hatchet or similar equipment so that the cuts are about 6 inches apart between centers. Inject ½ to 1 milliliter of undiluted Milestone into the pocket created between the bark and the inner stem/trunk by each cut as soon as possible after cutting. The cambium area next to the bark is the most vital area to wet.



# Method<sup>®</sup> 240SL

## HERBICIDE

Soluble Liquid  
For Non-Crop Use

ACTIVE INGREDIENT:	By Weight
Potassium salt of aminocyclopyrachlor	
Potassium salt of 6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid*	25%
OTHER INGREDIENTS:	75%
TOTAL:	100%

\*Acid Equivalent: 6-Amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid  
- 2 pounds acid per gallon or 21.2%

EPA REG. NO. 432-1565

## PRODUCT INFORMATION

METHOD 240SL HERBICIDE is a soluble liquid that is mixed in water and applied as a spray. METHOD 240SL HERBICIDE may be applied by aerial or ground equipment for control of broadleaf weeds and woody species, including many terrestrial and riparian invasive and noxious weeds. METHOD 240SL HERBICIDE is registered for general weed and brush control on private, public, and military lands as follows: uncultivated non-agricultural areas (such as airports, highway, railroad and utility rights-of-way, sewage disposal areas, etc.); uncultivated agricultural areas - non-crop producing (such as farmyards, fuel storage areas, fence rows, non-irrigation ditchbanks, barrier strips, etc.); industrial sites - outdoor (such as lumberyards, pipeline and tank farms, etc.); and natural areas (such as wildlife management areas, wildlife openings, and wildlife habitats). METHOD 240SL HERBICIDE may be used for the release or restoration of native perennial grasses and in established industrial turf grasses.

## INJECTION OR HACK AND SQUIRT

Inject or use a hatchet, machetes, or similar equipment to make downward cuts into the cambium (inner bark) of the stem in such a way as to make a "pocket" large enough to retain the applied solution. Cuts/injections may be made at a height convenient to the applicator. Make one cut/injection for every 2 inches of diameter at breast height (DBH) on the target stem. For example, an 8-inch DBH stem would require 4 cuts. Cuts should be made at equal intervals around the tree. Spray ½ - 1 milliliter (mL) of undiluted METHOD 240SL HERBICIDE into each cut.

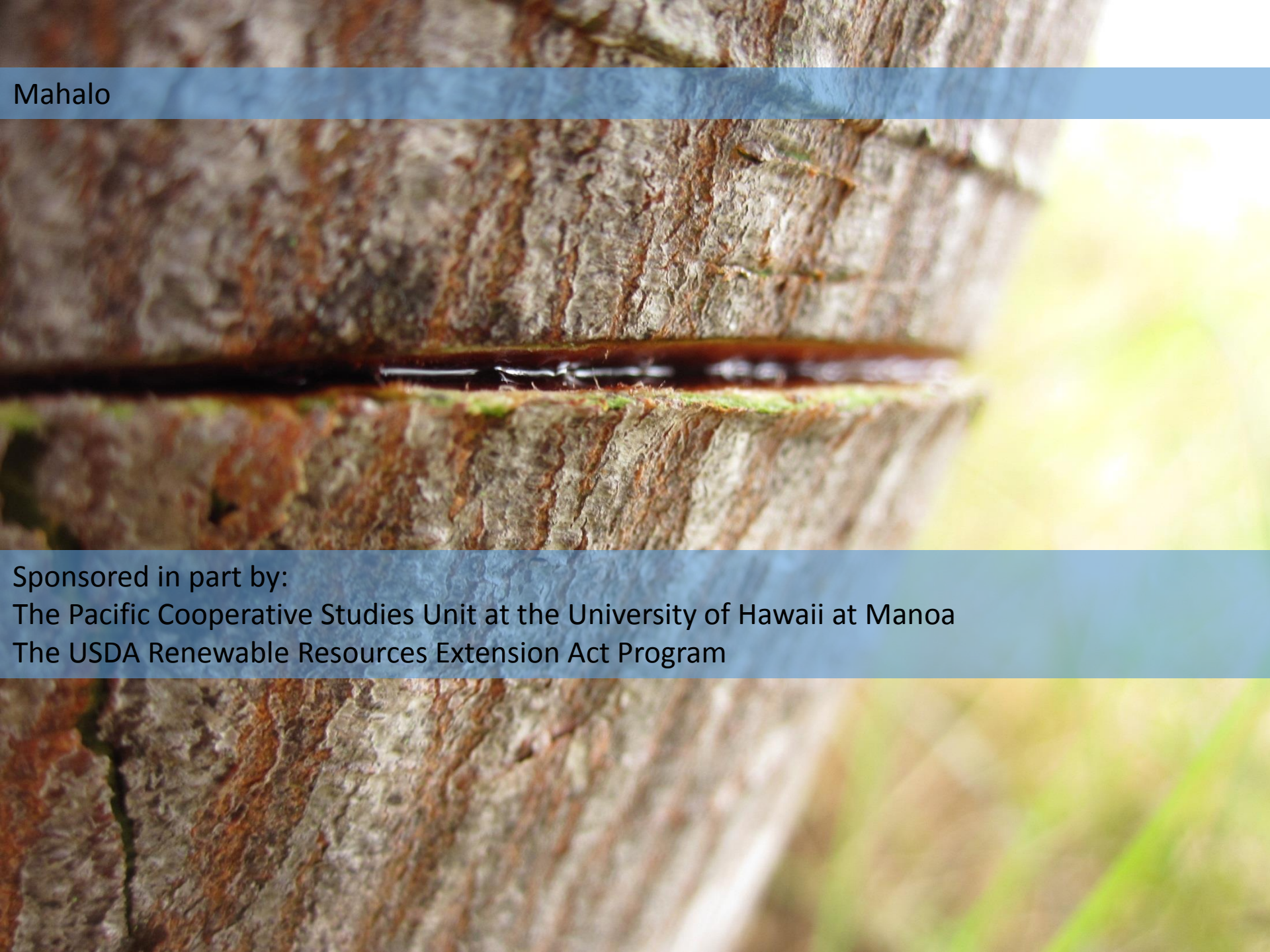




Conclusions: IPA is an effective method on woody species

- The injection is a sound experimental method for evaluating activity of a known amount
- ONE SIZE DOES NOT FIT ALL! Selection of the best species/herbicide match will optimize use rates in the field.
- A reaffirmation on the value of calibration at the individual plant level
- A highly consistent method transferable to operational settings
- Species of concern due to lack of herbicide performance: *Araucaria heterophylla*, *Casaurina equistifolia*, *Chrysophyllum oliviforme*, *Citharexylum caudatum*, *Corymbia citriodora*, *Cryptomeria japonica* and *Melaleuca quinqueveria*



A close-up photograph of a tree trunk, showing the rough, textured bark. A horizontal blue band runs across the middle of the image. The background is a soft, out-of-focus green, suggesting a forest setting.

Mahalo

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