



COLLEGE OF AGRICULTURE
AND LIFE SCIENCES

COOPERATIVE EXTENSION
School of Plant Sciences



Using Preemergence Herbicides in Western Orchards

Dr. Bill McCloskey,
Extension Weed Specialist
School of Plant Sciences

Weeds – What We Know



- Weeds compete with young trees for resources:
 - Stunt growth
 - Delay nut yield
- Weeds produce
 - seeds,
 - rhizomes,
 - tubers, etc.
- Soil Seed Bank

Weeds – What We Know



- Preemergence = PREE herbicides
- DO NOT control established perennial weeds.
 - Silverleaf nightshade
 - Field Bindweed
 - Hog potato
 - Johnsongrass
 - Bermudagrass
- Require treatment in late summer with glyphosate

Weeds – What We Know

- PREE Herbicides – Reduce emergence & density



Above: Monsoon rains prevented spraying – Biomass problem



Above: Pindar GT @ 3 pints/A
After 3 years of use

Measuring Percent Weed Ground Cover

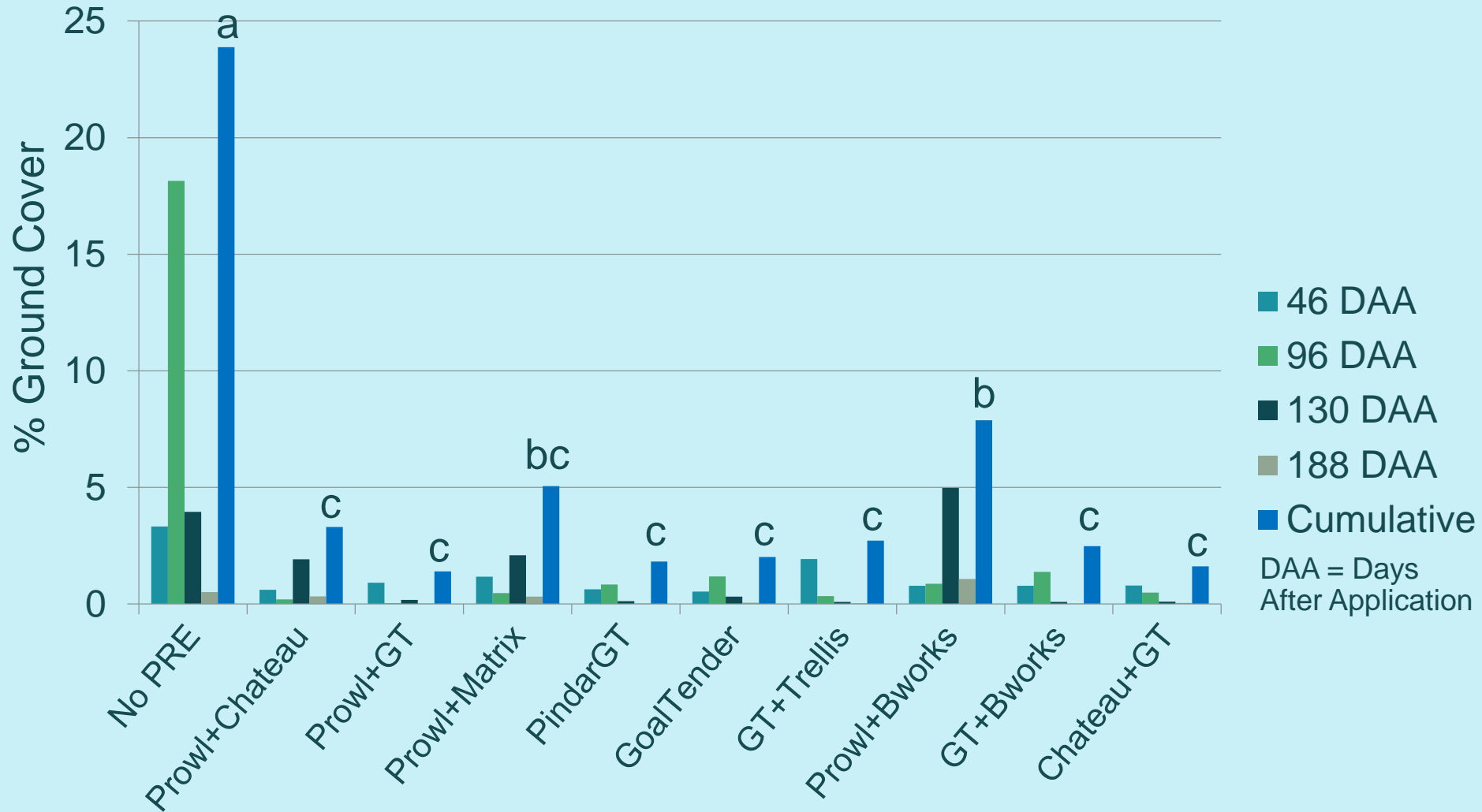
Photographic Analysis of Pixels (EasyLeaf)



Each photograph is a subsample; multiple photographs per plot

Ground Covered by Weeds in Pecans

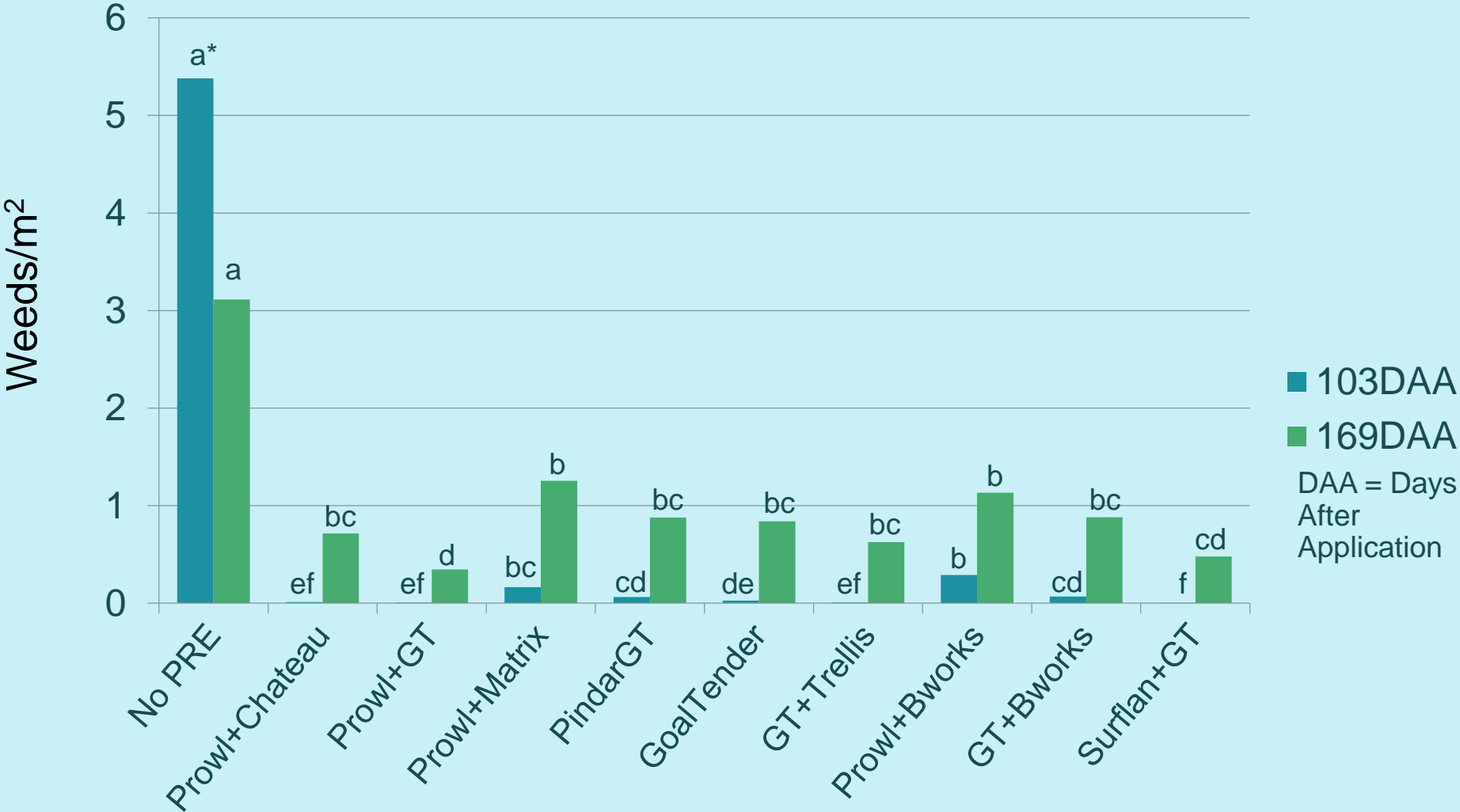
Bill McCloskey, A & P Growers, San Simon, AZ, 2017



*p = 0.05, SNK

Prostrate Spurge Control in Pecans

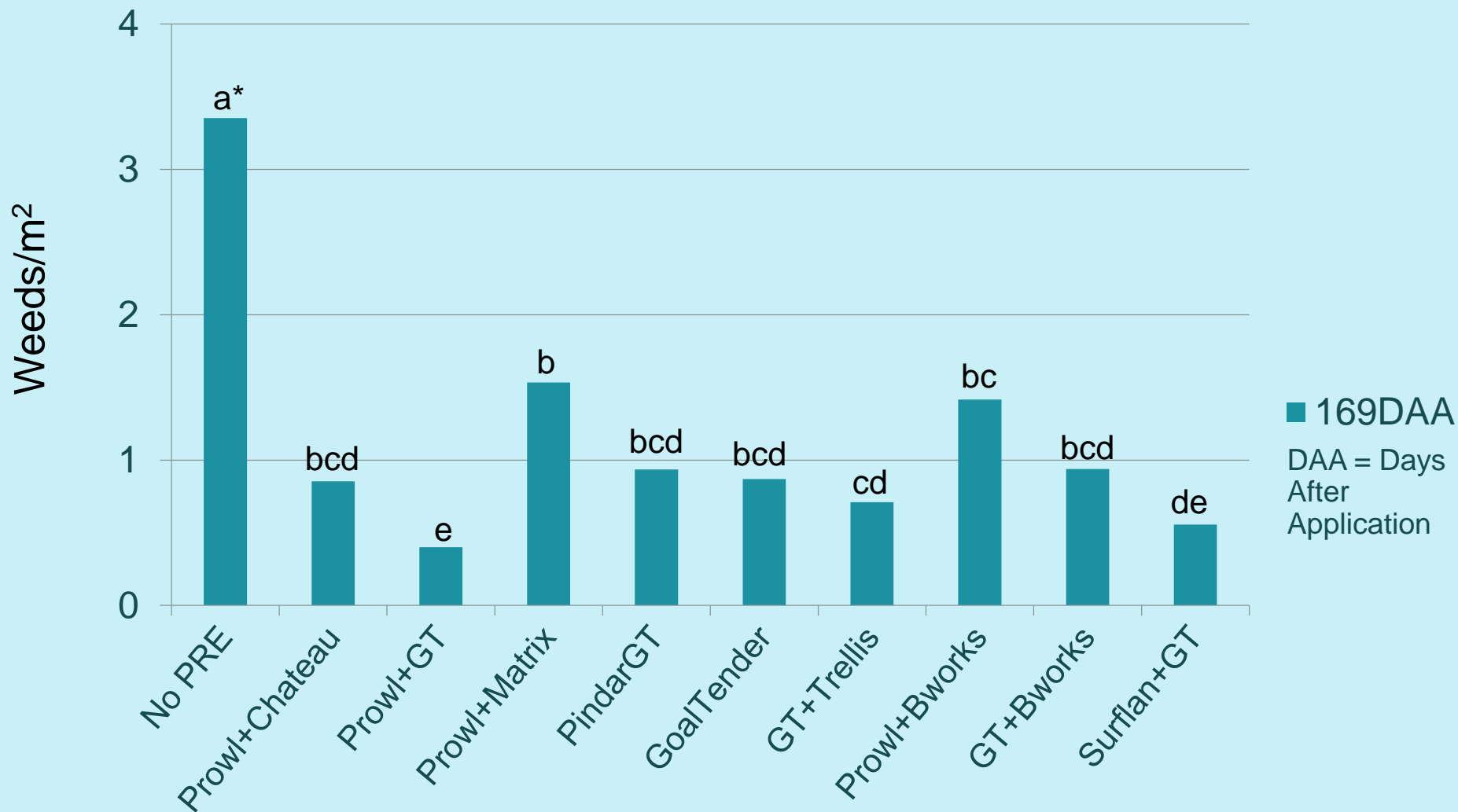
Bill McCloskey, FICO, San Simon, AZ, 2017



*p = 0.05, SNK

Broadleaf Weed Control in Pecans

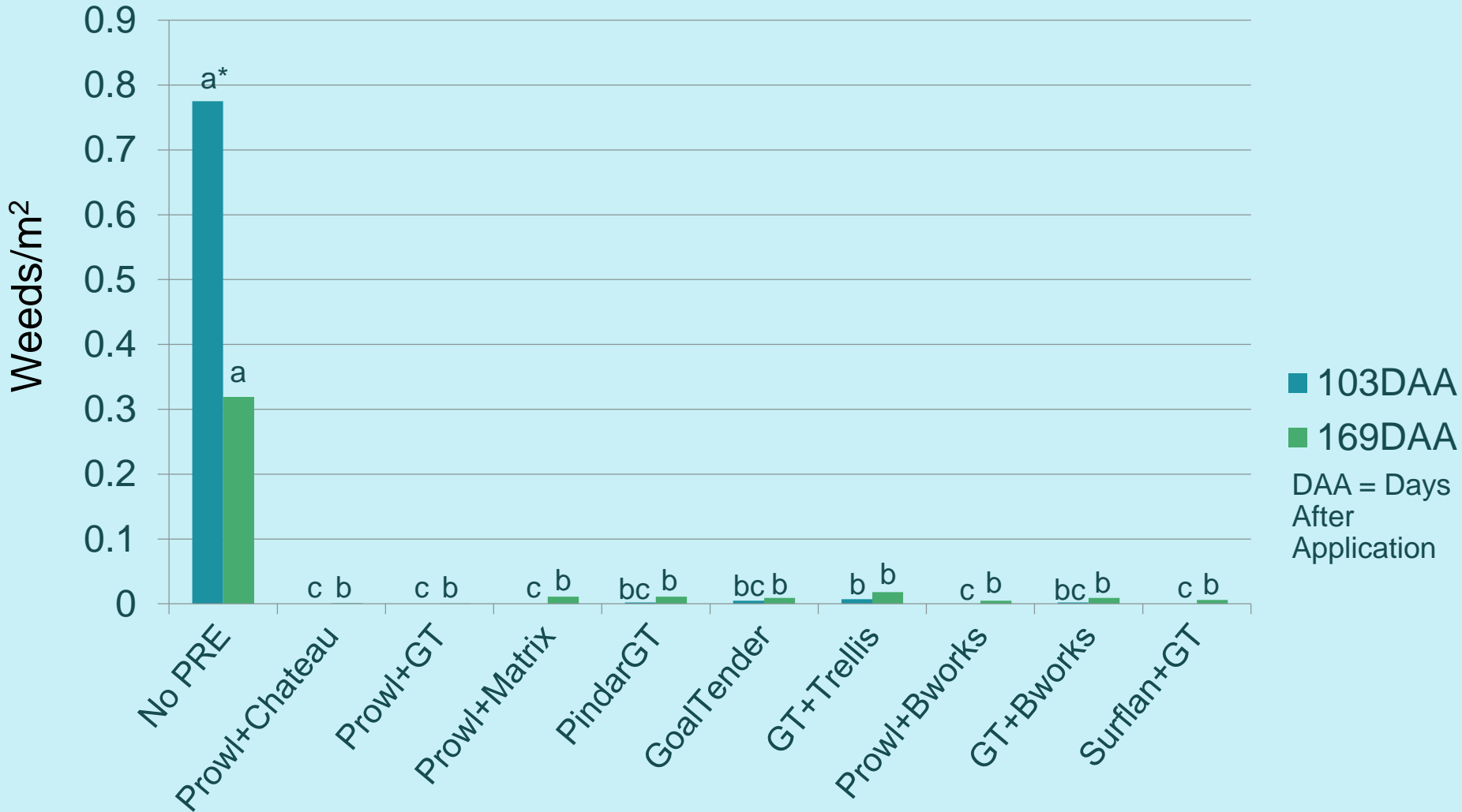
Bill McCloskey, FICO, San Simon, AZ, 2017



*p = 0.05, SNK

Grass Weed Control in Pecans

Bill McCloskey, FICO, San Simon, AZ, 2017



*p = 0.05, SNK

Weeds – What We Know

- PREE Herbicides – Reduce emergence & density
- PREE herbicides reduce the # of POST applications
- PREE herbicides suppress weeds in monsoon
- 2 or more years of use to reap full benefits



Above: Monsoon rains prevented spraying – Biomass problem



Above: Pindar GT @ 3 pints/A
After 3 years of use

Weeds – What We Know

Type of irrigation system matters



Flood – Less frequent anaerobic conditions



Drip – More frequent anaerobic conditions

Anaerobic soil conditions greatly increase the degradation of dinitroaniline herbicides (e.g., Prowl and Surflan) and loss of control compared to other PREE herbicides

Weeds – What We Know

Type of irrigation system matters – drip irrigation keeps soil wetter, longer, increasing the duration of anaerobic soil conditions



POST
only program



Prowl H₂O
4 qt./A



Pindar GT
3 pt./A

August 15, 2016

Weeds – What We Know

Type of irrigation system matters



POST
only program



Prowl H₂O
4 qt./A

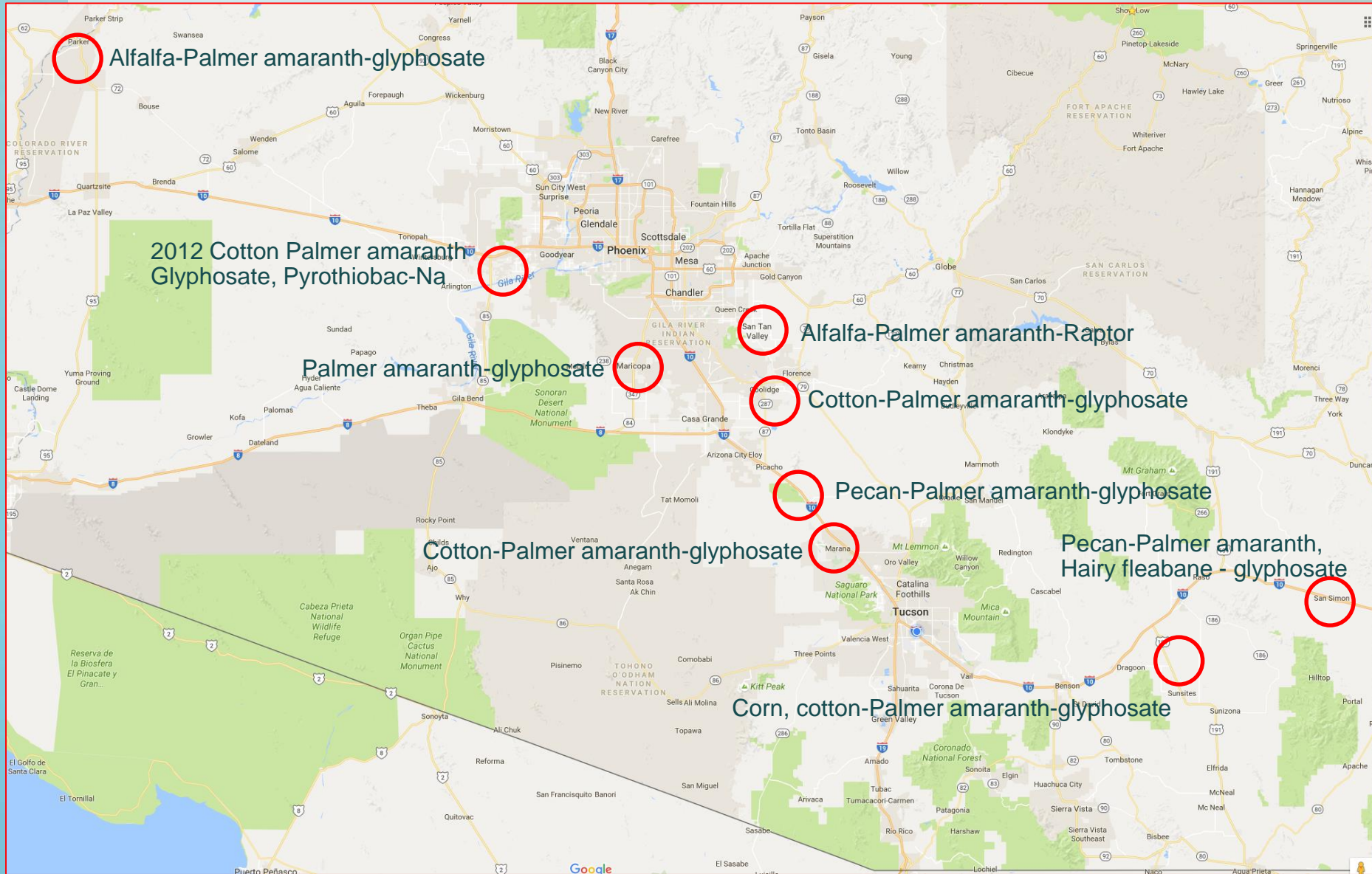


Pindar GT
3 pt./A

October 10, 2016 (6 months after treatment)

Problem of Herbicide Resistant Weeds

Glyphosate resistant Palmer amaranth & Hairy fleabane



Weed Management exerts selection pressure



Glyphosate resistant Palmer amaranth discovered in Buckeye, AZ in August 2012.

- Herbicides select for chemical Resistance
- Increase the diversity of herbicide mechanisms of action
- Use other weed management tactics to reduce selection

Potential Glyphosate resistant weeds in AZ

Horseweed (*Conyza canadensis*;
syn *Erigeron canadensis*)

Hairy fleabane (*Conyza
bonariensis*; syn *E. bonariensis*)



Anil Shrestha, Calif. State Univ. – Fresno (above)

Joseph M. DiTomaso,
Univ. of Calif. – Davis
(above); Bugwood.org

Robert Videki, Doronicum
Kft. (above left);
Rob Routledge, Sault
College (above right);
Bugwood.org

Horseweed (*Conyza canadensis*;
syn *Erigeron canadensis*)



Robert Videki,
Doronicum Kft. (left);
Bugwood.org

Rosette growth stage is
most susceptible to
postemergence herbicides

Hairy fleabane (*Conyza
bonariensis*; syn *E. bonariensis*)



Joseph M. DiTomaso,
Univ. of Calif. – Davis
(above); Bugwood.org

- Both species can germinate in the fall and over-winter in the basal rosette stage.
- Both species can germinate in the spring, grow rapidly and bolt.
- Both species can survive through the summer.
- Both species respond to mowing by growing multiple stems.

Herbicide Resistance in Hairy fleabane (*Conyza bonariensis*; syn *E. bonariensis*)



Glyphosate
Paraquat
Simazine,
ALS - chlorsulfuron

Country or State	Year	ALS	Glyphosate	Triazine	Paraquat Diquat
Spain	1987, 2004		X	X	
Egypt	1989				X
Japan	1989				X
Israel	1993, 2005	X	X	X	
South Africa	2003, 2003		X		X
Brazil	2005		X		
Columbia	2006		X		
California	2007		X		
California	2009		X		X
Multiple Resistance (corn, orchards, grapes, roadsides)					
Australia	2010, 2011, 2016		X X		X

Horseweed (*Conyza canadensis*; syn *Erigeron canadensis*)



Year	Site of Action	Actives
1980	PSI electron diverter (22)	paraquat
1981	PS II inhibitor (5 - triazines)	atrazine
1988	PS II inhibitor (7 – ureas)	linuron
1993	ALS inhibitor (2)	pyrithiobac
2000	ALS inhibitor (2)	Imazapyr
2000	EPSP synthase inhibitor (9)	glyphosate

Robert Videki, Doronicum Kft. (above left);
 Rob Routledge, Sault College (above right);
 Bugwood.org

Several instances of multiple resistance

MOA 2 & 5 (Israel – forests, roadsides)

MOA 5 & 7 (Michigan - blueberries)

MOA 2 & 9 (Michigan – soybean)

MOA 22 & 9 (Mississippi – soybean)

MOA 22 & 9 (California – Almonds)

Kochia or burningbush (54 cases in U.S.) *Bassia scoparia* (L.) A.J. Scott

Kochia Herbicide Resistance in Colorado (individually) & Kansas (multiple resistance)

Year	Site of Action	Actives
1982	Photosystem II inhibitors (5)	Atrazine
1989	ALS inhibitors (2)	Metsulfuron, Triasulfuron
1999	Synthetic Auxins (0)	Dicamba
2012	EPSP synthase inhibitors (9)	glyphosate



Photo: Steve Dewey, Utah
State University, Bugwood.org

Photo: Howard F. Schwartz, Colorado
State University, Bugwood.org

Kochia tumble-weed path in onion field *Bassia scoparia* (L.) A.J. Scott



Left Photo Credit: Phil Westra, Colorado State University, Bugwood.org

Photo credit: M.E. Bartolo, Bugwood.org

Weed Management Programs – Need Diversity

- Weed free strip – tree line
- Mow middles
- Preemergence (PREE) Herbicide
 - “Foundation” PREE
 - Pindar or GoalTender
 - Prowl H₂O or Surflan
 - Chateau+GoalTender
 - “Supplemental” PREE – Increase weed control (species & numbers)
 - Matrix
 - Trellis
 - Broadworks



Preemergence Pecan Herbicides (X = bearing, NB = nonbearing)

Trade name	Common name	Pecans/ Pistachios	Weeds controlled
Pindar GT	penoxsulam oxyfluorfen	X / X	Broadleaves and grasses
Goal Tender	Oxyfluorfen	X / X	
Surflan	Oryzalin	X / X	Grasses & small seeded broadleaves, suppression of large seeded broadleaves.
Prowl H ₂ O	Pendimethalin	X / X	
Matrix FNV	Rimsulfuron	X / X	Broadleaves, grasses, yellow nutsedge – also POST activity
Chateau	flumioxazin	X / X	Broadleaves, some grasses
Trellis	isoxaben	X / -	Broadleaves and grasses – also POST activity
Karmex, Diuron	Diuron	X / -	Broadleaves & grasses; has leaching potential
Solicam	Norflurazon	X / X	Grasses, broadleaves, nutsedges
Broadworks	Mesotrione	X / X	Annual broadleaves

Weed Management Programs



- Preemergence (PREE) Herbicide
 - “Foundation” PREE
 - Pindar or GoalTender – better under drip than dinitroanilines
 - Prowl H₂O or Surflan – loses activity in anaerobic or water saturated soils.
 - Chateau+GoalTender
 - “Supplemental” PREE – Increase weed control (suppresses difficult species & reduces numbers)
 - Matrix – hairy fleabane
 - Trellis – hairy fleabane
 - Broadworks

Preemergence Pecan Herbicides

MOA = mechanism of action, POST = postemergence

Trade name	MOA	POST Activity	Product Rate	Annual maximum	Max. time to incorporate
Pindar GT	2+14	Contact	1.5 – 3 pt/A	4.5 pt/A	21 days
GoalTender	14	Contact	2.5 – 3 pt/A (4 pt/A banded)	3 pt/A (4 pt/A banded)	3 to 4 weeks
Surflan	3	No	2 – 6 qt/A	12 qt/A	1 week
Prowl H ₂ O	3	No	2 – 6.3 qt/A	6.3 qt/A	1 week
Matrix FNV	2	Translocated	4 oz/A	4 oz/A, if ≤50% band, 8 oz/A	2 to 3 weeks
Chateau	14	Contact	6 – 12 oz/A	24 oz/A	Extended period
Trellis	21	No	0.66 – 1.33 lb/A	1.33 lb/A	21 days
Solicam	12	Translocated	2.5 lb/A coarse 3.75 lb/A medium	Same as rate	4 weeks
Broadworks	27	Translocated	3 – 6 fl oz/A	12 fl oz/A	7 to 10 days

Timing of PREE Application(s)



Clean surface for application of PREE herbicides

- Spring: target=warm season weeds
 - Anytime
 - Prowl (pendimethalin)
 - Surflan (oryzalin)
 - Chateau (flumioxazin) – tank mix partner
 - Up to emergence of green tissue (dormant) or after nut set (non-dormant)
 - Pindar GT (oxyfluorfen+penoxsulam)
 - Before February 15th or bud swell (dormant trees)
 - GoalTender (oxyflourfen)
 - Do not apply GoalTender during the period between bud swell and completion of final harvest or when fruit/nuts are present

Timing of PREE Application(s)



Clean surface for application of PREE herbicides

- Year Long Weed Control?
- Winter (after final) harvest
 - Prowl (pendimethalin) – 2-3 qt./A
 - Surflan (oryzalin) – 2-3 qt./A
 - Goal (oxyfluorfen) – 3 pt./A
 - “Supplemental” PREEs – more species (e.g., hairy fleabane)
 - Matrix, Trellis, Chateau, Broadworks
- Spring/Summer
 - Pindar GT (oxyfluorfen+penoxsulam)
 - Prowl, Surflan
 - Chateau – tank mix partner

Systemic Postemergence Pecan Herbicides

(X = bearing, NB = nonbearing)

Trade name	Common name	Pecans/ Pistachios	Herbicide type, weeds controlled
Select	Clethodim	NB / NB	Systemic, selective; controls only grass weeds
Fusilade DX	Fluazifop-p-butyl	X / NB	
Poast	Sethoxydim	X / X	
Sandea	halosulfuron	X / X	Systemic, selective; controls nutsedge species and some broadleaf weeds
Roundup, Touchdown, etc.	glyphosate	X / X	Systemic, non- selective; Controls green herbaceous plants

Contact Postemergence Pecan Herbicides (X = bearing, NB = nonbearing)

Trade name	Common name	Pecans/ Pistachios	Herbicide type, weeds controlled
Rely, Lifeline	Glufosinate-ammonium	X / X	Contact, non-selective; controls green herbaceous plants Medium to coarse droplets Add surfactant, COC, MeOH
Gramoxone Paraquat	Paraquat (restricted use)	X / X	
Aim	Carfentrazone	X / X	Contact, selective; controls broadleaf weeds; both Chateau and Goal have soil residual activity at higher rates.
Venue	Pyraflufen ethyl	X / X	
Chateau	Flumioxazin	X / X	
Goal Tender, Goal	Oxyfluorfen	X / X	
Treevix	Saflufenacil	- / X	

Spray Quality Categories

ASABE Standard S-572.1

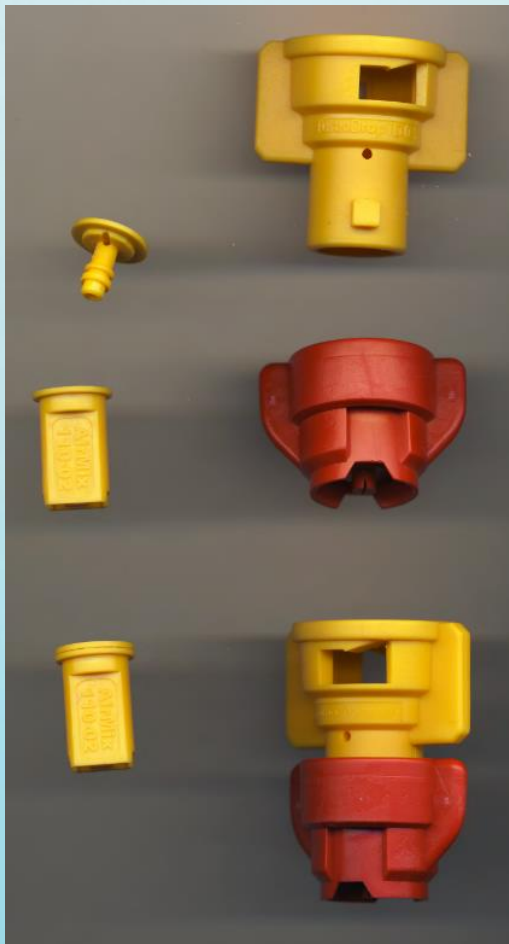
<i>Category (symbol)</i>	<i>Color Code</i>	<i>VMD Range</i>
Extra Fine (XF)	Purple	< 60
Very Fine (VF)	Red	61 – 144
Fine (F)	Orange	145 – 235
Medium (M)	Yellow	236 – 340
Coarse (C)	Blue	341 – 403
Very Coarse (VC)	Green	404 – 502
Extremely Coarse (XC)	White	503 – 665
Ultra Coarse (UC)	Black	> 665

CONTACT

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C

PRE
E

- Air induction nozzles at moderate pressure (e.g., 40 PSI) produce very large spray droplets



AirMix, TDXL
(GreenLeaf)



AI – Air Induction

**TTI Turbo Teejet
Induction**

**AIXR – Air
Induction
Extended Range**

TeeJet Induction nozzles

Air induction nozzles can generate large spray droplets!

Medium Pressure TurboDrop

Part Numbers

- TADF/TACDF01
- TADF/TACDF015
- TADF/TACDF02
- TADF/TACDF025
- TADF/TACDF03
- TADF/TACDF04
- TADF/TACDF05
- TADF/TACDF06
- TADF/TACDF08
- TADF/TACDF10
- TADF/TACDF15



Air Induction Turbo TwinJet®



AI – Air Induction



TTI Turbo Teejet Induction



TTI TwinJet

Spray Quality Categories

ASABE Standard S-572.1

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PRE
E

Tree nut weed management tactics

- Need a diversity of tactics to delay development of herbicide resistant weeds
 - Sanitation – minimize weed seed production
 - Tillage/mowing
 - Preemergence herbicide
 - Additional herbicide mechanism of action (MOA)
 - Reduce postemergence herbicide sprays
 - Postemergence herbicides
 - Tank-mix herbicides
 - Rotate herbicides & MOA