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WHICH HERBICIDE?: CHOOSING, COMPARING, AND SELECTING HERBICIDE COMBINATIONS FOR BROADLEAF WEED CONTROL

Dr. Aaron Patton
@PurdueTurfDoc

A multi-state, Purdue UNIV. Publication:
Turfgrass Weed Control for Professionals

Authors: Dr. Aaron Patton and collaborators (16 states)

Quick help for identifying and managing weeds

2021(10th ed.) Available at **Purdue Education Store**
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Turfgrass Weed Control for Professionals

Full-color ID of 118 weeds

Rubus (Rosa Family)



Other Common Name: Rose species

- Common in cool-season turf
- Leaves are serrated
- Flowers are white to pink
- Fruit is a cluster of small drupelets
- Can be a pest in lawns
- Can be a pest in golf courses
- Can be a pest in parks

Waltipha spicata — Black Grass



Other Common Name: Black grass

- This is a common annual broadleaf weed
- It is a member of the grass family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family

Poa annua — Annual Bluegrass



Other Common Name: Annual bluegrass

- This is a common annual broadleaf weed
- It is a member of the grass family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family

Poa trivialis — Rough Bluegrass



Other Common Name: Rough bluegrass

- This is a common annual broadleaf weed
- It is a member of the grass family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family
- It is a member of the Rubus family

Turfgrass Weed Control for Professionals

- Covers which herbicides work best for each weed

Postemergence Herbicides

Weed Control Ratings for Postemergence Broadleaf Herbicides

Herbicide	Canada thistle	chickweed, common	chickweed, moss-ear	cleaver, white	dandelion	garlic, wild (onion)	henbit	ground ivy	groundsel, prostrate	legume	mallow	plantain	purple deadnettle	purple, common	shepherd's purse	speedwell, common	sprague, prostrate	strawberry, Indian muck	wild radish	yellow nodium
2,4-D (Weedab4, Weedone UK, others)	G	P	P	P	E	G	F	F	P	G	G	G	G	G	G	P	F	F	F	P
2,4-D + dicamba (Dn Beck)	G	F	E	G	E	G	F	F	G	G	G	G	G	G	G	P	G	F	F	P
2,4-D + dichlorop (2,4-DP)	G	G	G	F	E	G	E	F	F	G	E	G	G	G	G	F	G	F	G	P
2,4-D + dcpyd + dicamba (Mikentium Ultra 2)	F	G	E	E	E	G	E	F	G	G	G	G	G	G	G	P	G	F	F	P
2,4-D + dichlorop + dicamba (Bophastrer)	E	G	E	G	E	G	E	F	G	E	G	E	G	G	G	F	F	F	P	P
2,4-D + fluroxyp + dicamba (Escalade 2)	E	G	E	G	E	G	E	G	E	G	E	G	E	G	G	P	G	F	F	E

and more

Turfgrass Weed Control for Professionals

- Covers the control of tough weeds

Control of Tough Weeds

A to Z and everything in between

Annual Bluegrass


Annual bluegrass (*Poa annua*) is a common weed in turfgrass. It is a member of the grass family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family.

Zoysiagrass

Zoysiagrass (*Zoysia sp.*) is a member of the grass family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family. It is a member of the Rubus family.

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- Broadleaf herbicides are largely postemergence.
- Postemergence herbicides in turf are mostly synthetic auxins (2,4-D).



2,4-D, MCPP, dicamba

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FIRST WAVE OF BROADLEAF HERBICIDES

- Since 1960's
 - 2,4-D
 - Mecoprop
 - Dichlorprop
 - MCPA
 - Dicamba

} Three-way mixtures common
*Blue are phenoxy herbicides

- Trade Names: Trimec, Triamine, Triplet, others

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FIRST WAVE OF HERBICIDES

Herbicide	White clover	Dandelion
2,4-D	P	E
dichlorprop (2,4-DP)	P	P
MCPA	F	G
MCPP, mecoprop (Mecomec)	F	P
dicamba (Banvel, Vanquish)	E	P

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2ND WAVE OF BROADLEAF HERBICIDES

- Since 1980 and 1990's
 - Triclopyr (Turflon Ester)
 - Clopyralid (Lontrel)
- Trade Names: Confront, Millennium Ultra, Cool Power, Horsepower, Chaser, Momentum FX2, others
- Fluroxypyr came later in 2000s

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ANOTHER BROADLEAF HERBICIDES

- Quinclorac is a quinolinecarboxylic acid herbicide
- It is a unique synthetic auxin that kills broadleaf weeds and some grasses – although often known primarily for crabgrass control
- Developed in the early 1980s by BASF
- The turf product Drive become available in the late 1980s with other generic formulations now available

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3RD WAVE OF BROADLEAF HERBICIDES

- Starting in 2019 - arylopicolinates
 - Arylex (halauxifen-methyl) – containing herbicides
 - Rinskor (florpyrauxifen-benzyl) – possibly in the future in turf
- Trade Names of Arylex-containing herbicides: GameOn

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AUXINIC HERBICIDES

Herbicide Class	Active Ingredient	Trade Name	Price
Phenoxy-carboxylic acids	2,4-D	Various	Lowest ↓ Highest
	Dichlorprop (2,4-DP)	Various	
	MCPA	Various	
	Mecoprop MCPP	Various	
Benzoic acids	Dicamba	Banvel, Clarity, Vanquish	
Pyridinecarboxylic acids	Clopyralid	Stinger, Reclaim, Transline, Lontrel	
	Fluroxypyr	Starane, Attain, Vista XRT	
	Triclopyr	Garlon, Turflon Ester	
Quinolinecarboxylic Acids	Quinclorac	Drive XLR8, Facet, Paramount	
Arylopicolinic acids	Halauxifen-methyl	Arylex (GameOn)	

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Broadleaf herbicides are largely synthetic auxin herbicides that are applied postemergence.

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4TH WAVE INCLUDES "FASTER" HERBICIDES

These are typically in the "4-way" herbicide mixtures

- PPO inhibitors
 - 2002 – carfentrazone introduced as **QuickSilver** in the PBI Gordon "Zone" products. SpeedZone, PowerZone, SpeedZone Southern
 - 2006 – sulfentrazone introduced in **Dismiss** and now many other products like Q4 Plus, Solitaire, Surge, TZONE
 - 2008 – pyraflufen-ethyl introduced as **Octane**. Similar to carfentrazone. 4-Speed, 4-Speed XT, Redzone 2
 - 2018 – flumioxazin introduced as **SureGuard** alone. This herbicide is added at a very low rate to SurePower, Tetra.

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BROADLEAF HERBICIDE MIXTURES

- There are a number of 2, 3, and even 4-way growth regulator herbicide combinations
- There are also herbicide ratio differences

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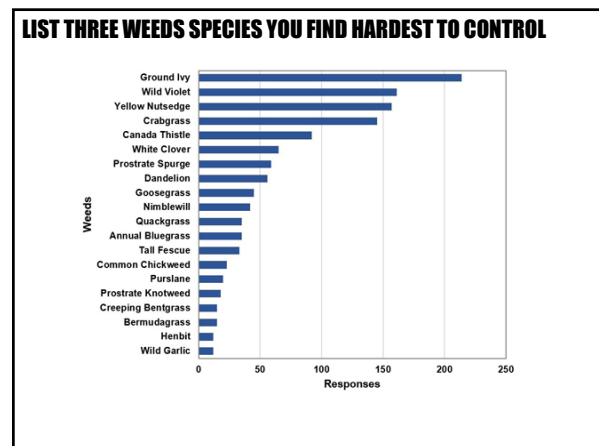
Turfgrass Weed Control for Professionals

- Provides handy comparisons of broadleaf herbicide ingredients

Active Ingredients in Commonly Used Postemergence Herbicide Combinations

This table only shows broadleaf herbicides with more than one ingredient or herbicides that are a key ingredient in mixtures. This table compares ingredients and allows users to quickly search for products that contain a particular ingredient. Each cell shows the amount of active ingredient at the low and high label rates in pounds of active ingredient or acid equivalent per acre.

Herbicides	2,4-D	Trifluralin (MKP)	dicamba	carfentrazone	glyphosate	glufosinate (GLF)	fenoxaprop	fluroxypyr	loxynil feron	MCPA	penoxsulon	pyraflufen-ethyl	spinetoril	sulfentrazone	thiencarbazone	indigo-1
2,4-D Amine 4, Bar-rage HP, Clean Amine, Humulol, Solace, Stenodier 2,4-D 10X, Stenodier 2,4-D 10K, Stenodier Amine 4, Stenodier E-99, WEEDlectry AMH, Weedone LHT EC, Weedar 64	1.0-1.9															
Z9Q	0.6-1.2		0.04-0.13									0.04-0.12				
3-O, Eliminate US, Endran, MEC Amine 3, Samba 3, Threosone, Trimec 899, Trimec 992, Trimec 1000, TripleT, TripleT Low Odor, TripleT SF, Vessol	0.5-1.2	0.15-0.33	0.05-0.11													
4-Speed XT	0.5-1.1		0.06-0.14									0.001-0.003				0.06-0.14
Aquasweep, Chaser 2 Amine	0.7-1.4															0.27-0.54
Amenue South	0.18-0.48		0.05-0.11								0.02-0.06			0.02-0.06		
Banvel, Clack, Cruise Control, Diablo, Sterling Blue, Vanquish, Vision			0.25-1.0													
BattleShip III								0.05-0.14		0.7-1.4						0.03-0.15
Brushmaster, Super Trimec	0.5-0.75		0.25-0.38		0.12-0.18											
Celstar WG			0.09-0.18						0.003-0.006							0.014-0.027
Change Up			0.06-0.15					0.06-0.15		0.43-1.5						
Chaser, Crossroad, Everett	0.5-1.0															0.25-0.51



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WHY ARE THESE WEEDS SO HARD TO CONTROL?

- Because you're using the wrong herbicide
- Some populations are resistant/tolerant?

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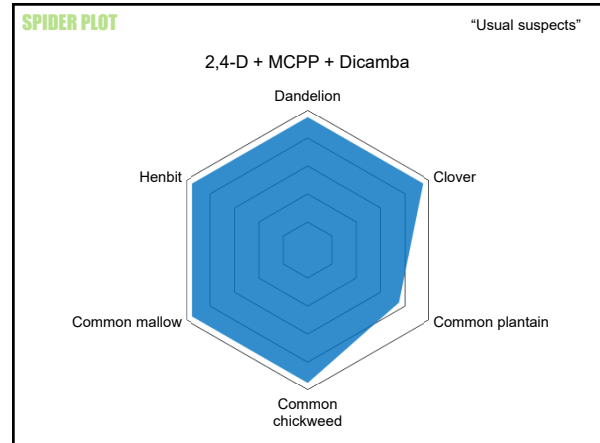
AUXINIC HERBICIDES

Herbicide Class	Active Ingredient	Trade Name	Price
Phenoxycarboxylic acids	2,4-D	Various	Lowest ↓ Highest
	Dichlorprop (2,4-DP)	Various	
	MCPA	Various	
	Mecoprop MCPP	Various	
Benzoic acids	Dicamba	Banvel, Clarity, Vanquish	
	Clopyralid	Stinger, Reclaim, Transline, Lontrel	
Pyridinecarboxylic acids	Fluroxypyr	Starane, Attain, Vista XRT	
	Triclopyr	Garlon, Turfion Ester	
Quinolinecarboxylic Acids	Quinclorac	Drive XLR8 , Facet, Paramount	
Arypicolinic acids	Halaxifen-methyl	Arylex (GameOn)	

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LET'S DISCUSS THIS SOME MORE

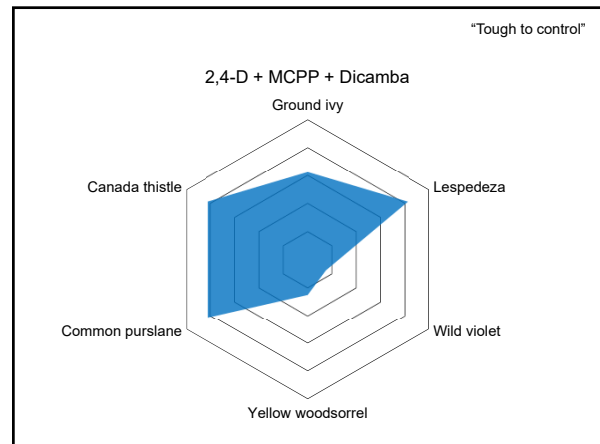
Herbicide	White clover	Dandelion	Common chickweed
2,4-D	P	E	P
dichlorprop (2,4-DP)	P	P	G
MCPA	F	G	E
MCPP, mecoprop (Mecomec)	F	P	F
dicamba (Banvel, Vanquish)	E	P	E
clopyralid (Lontrel)	E	F	P
fluroxypyr (Vista XRT)	E	F	E
triclopyr (Turfion Ester Ultra)	F	P	P
quinclorac (Drive XLR8)	E	F	P

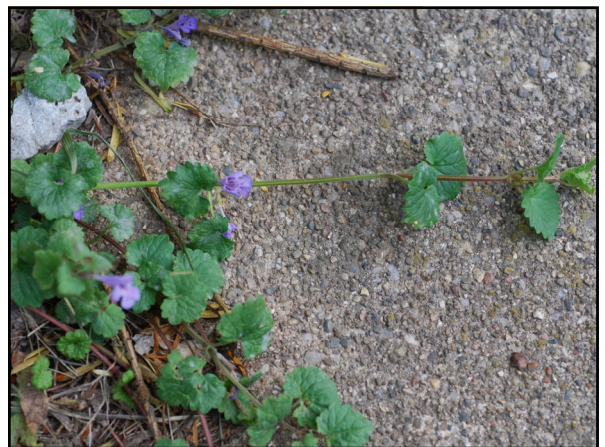


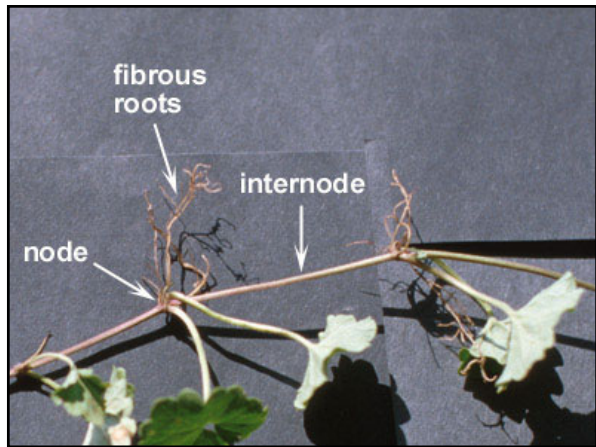
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TRIMEC, TRIPLET & TRIAMINE FORMULATIONS
(2,4-D + MCPP + Dicamba)

Consistent Control	Possible Escapes
<ol style="list-style-type: none"> 1. Dandelion 2. Common plantain 3. White clover 4. Carolina geranium 5. Chickweeds 6. Common mallow 	<ol style="list-style-type: none"> 1. Ground ivy 2. Wild violet 3. Yellow woodsorrel 4. Speedwells 5. Lespedeza 6. Indian mock-strawberry 7. Thistles 8. Buckhorn plantain



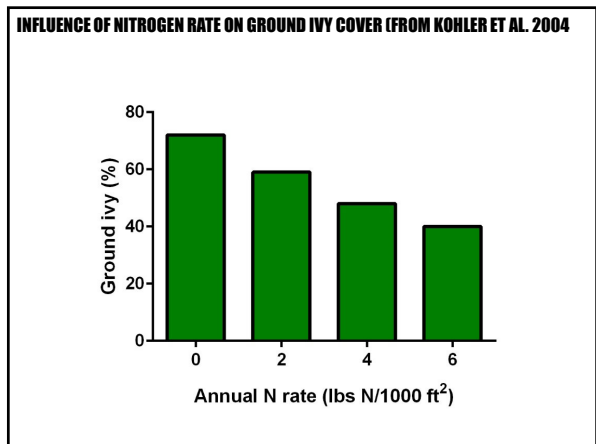




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CULTURAL CONTROL

- Management practices such as improving surface drainage, watering deeply and infrequently, and cultivating (aeration) compacted soils may hinder the development of ground ivy in favor of a more dense, aggressive turf.
- Nitrogen fertilization will also provide some reduction of ground ivy cover in turf.



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BEST HERBICIDES FOR GROUND IVY

- For post emergence control use
- Triclopyr containing products
 - Chaser
 - Momentum FX2
 - Turflon Ester Ultra
 - T-Zone
 - 4-Speed XT
 - Battleship III
 - CoolPower
 - HorsePower
 - Tailspin
 - Confront – not in residential turf
- Fluroxypyr containing products
 - Escalade 2
 - Momentum FX2
 - Battleship III
 - Chaser Ultra 2
 - Strike Three Ultra 2
 - Tailspin

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PHOTOS OF THE RESEARCH





Turfgrass Weed Control for Professionals

- Covers which herbicides work best for each weed

Postemergence Herbicides

Weed Control Ratings for Postemergence Broadleaf Herbicides

Herbicide	Common dandelion	Dichloroprop	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell	Stem cell
2,4-D (WeedAid, Weedon 10L, others)	G	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
2,4-D + dicamba (BioSelect)	G	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
2,4-D + dichloroprop (2,4-DP)	G	G	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + clopyralid + dicamba (Widestrike Ultra)	E	G	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + dichloroprop + dicamba (BioSelect)	E	G	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + fluroxypyr + dicamba (Escalade 2)	E	G	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + MCPA + dicamba (Tand Select)	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + MCPA + dicamba + sulfentrazone (BioSelect)	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + MCPA + dichloroprop (Siamis)	G	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + MCPA + dicamba (Eliox, Toplet, others)	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + MCPA + dicamba + pyridinone-ethyl (BioSelect)	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
2,4-D + spinetor + dicamba (SPQ, Monostorm Q, Oxytop)	E	F	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E

and more

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LET'S DISCUSS THIS SOME MORE

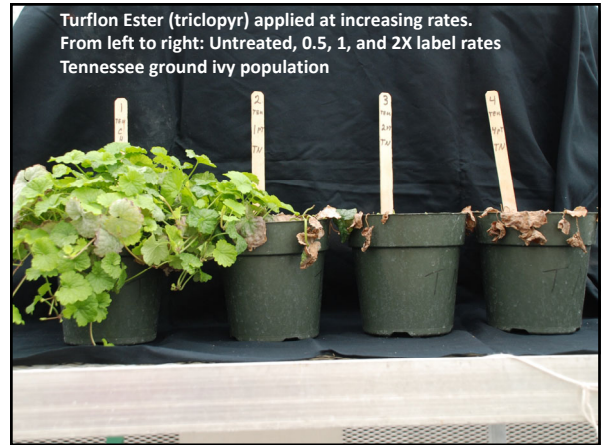
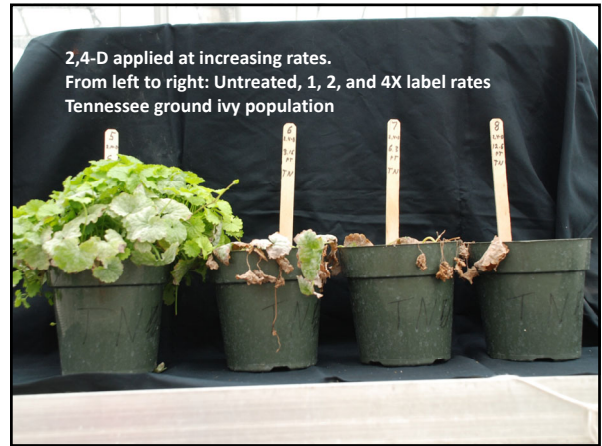
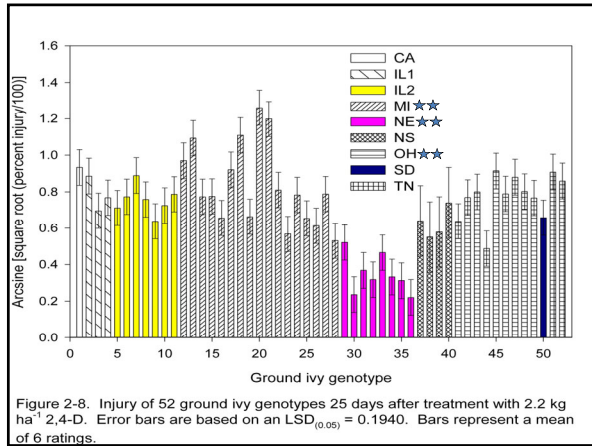
Herbicide	ground ivy	wild violet
2,4-D	F	P
dichloroprop (2,4-DP)	P	P
MCPA	P	P
MCPP, mecoprop (Mecomec)	P	P
dicamba (Banvel, Vanquish)	P	P
clopyralid (Lontrel)	P	P
fluroxypyr (Vista XRT)	G	P
triclopyr (Turflon Ester Ultra)	G	G
quinclorac (Drive XLR8)	F-P	P

Dow AgroSciences

Turflon® Ester Ultra

- For spot treatments, do not apply more than 2 quarts of Turflon Ester Ultra per acre or 1.5 fl oz per 1000 sq ft in a single application.

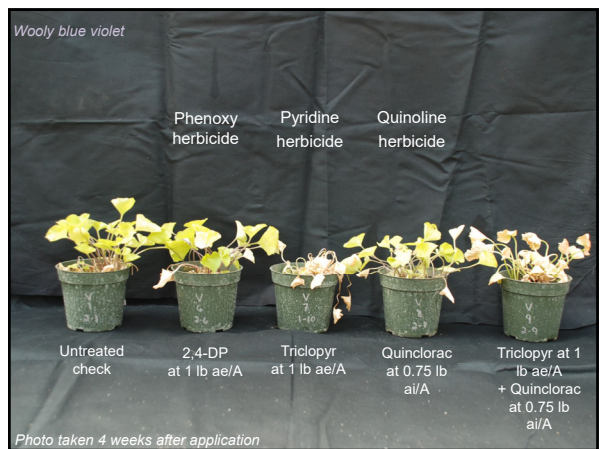
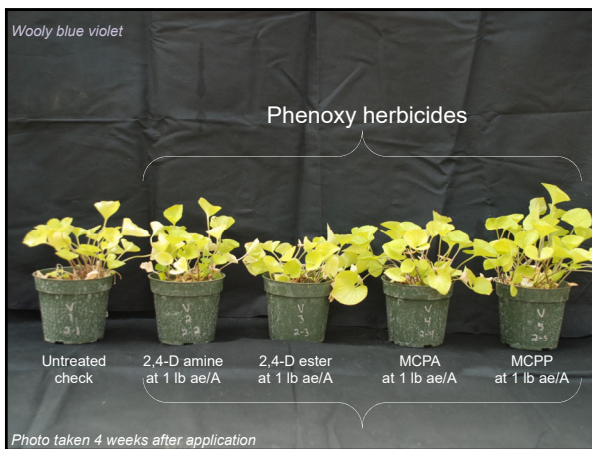
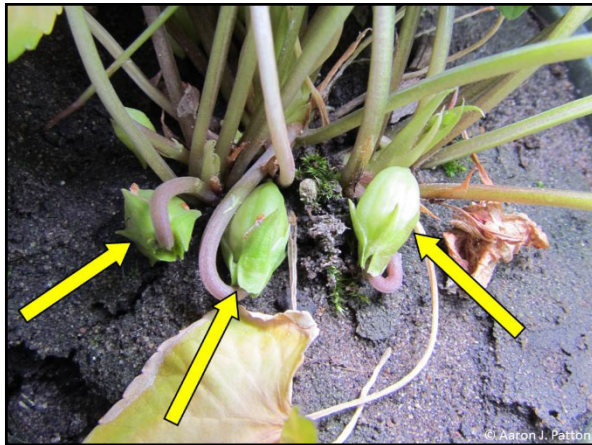
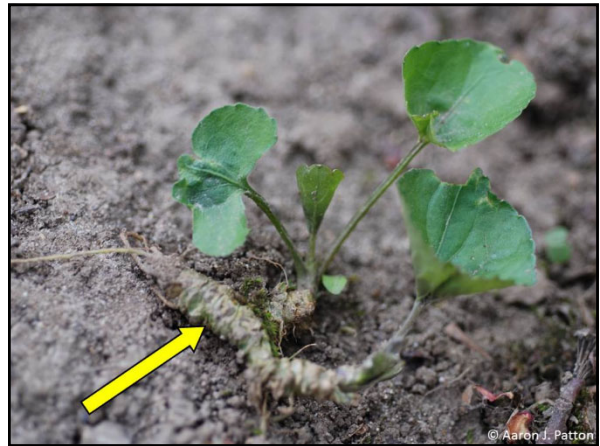
Tank Mixing: To improve the spectrum of activity, Turflon Ester Ultra may be tank mixed at a rate of 1/2 to 1 pint per acre with recommended rates of low volatile amine or ester formulations of 2,4-D, MCPA, or other labeled postemergence broadleaf herbicides provided the tank mix product is registered for use on ornamental turf (perennial bluegrass, perennial ryegrass, or tall fescue ornamental turf including these turfgrasses in sod farms and golf courses). Refer to the product labels of tank mix products and follow all appropriate use directions, precautions, and limitations.



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WILD VIOLET



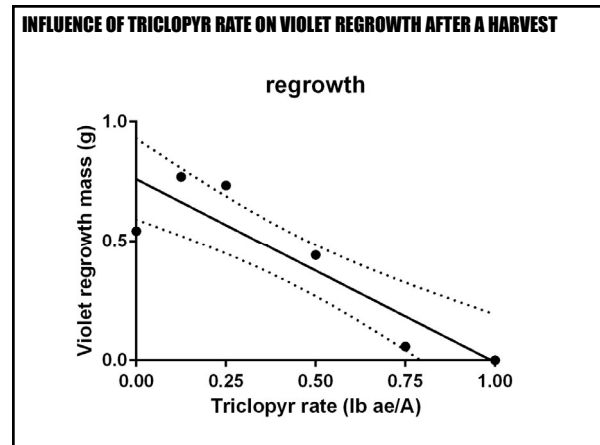
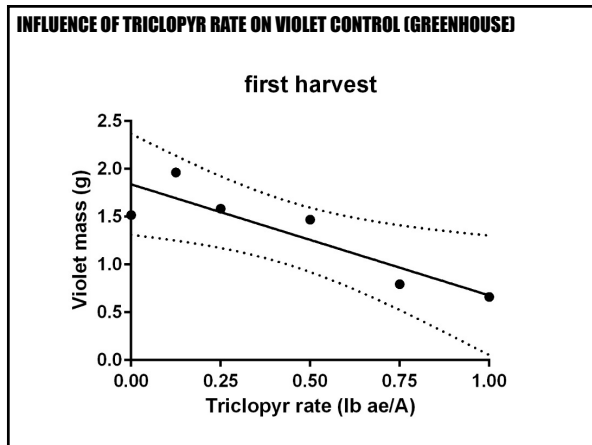


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EFFICACY OF AUXIN HERBICIDES

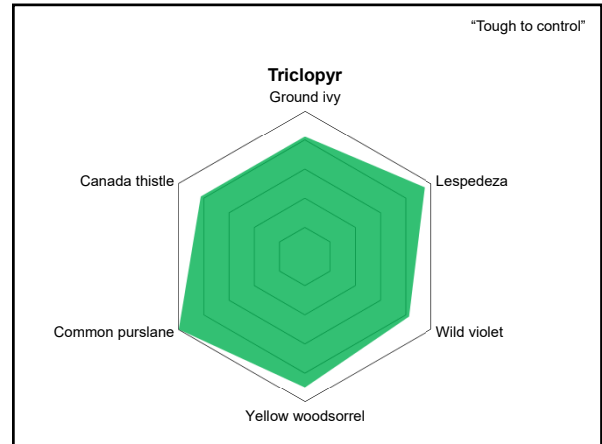
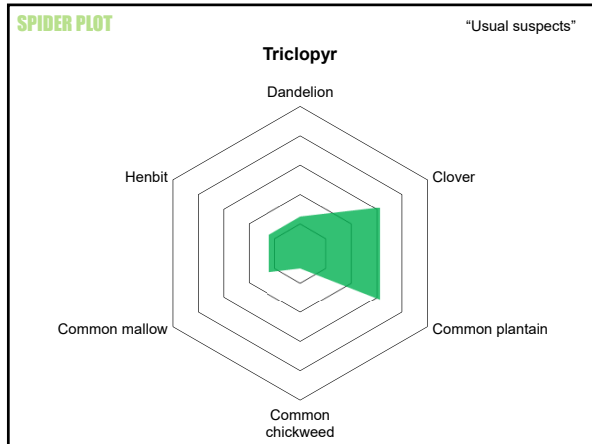
Herbicide	ground ivy	wild violet
2,4-D	F	P
dichlorprop (2,4-DP)	P	P
MCPA	P	P
MCPP, mecoprop (Mecomec)	P	P
dicamba (Banvel, Vanquish)	P	P
clopyralid (Lontrel)	P	P
fluroxypyr (Vista XRT)	G	P
triclopyr (Turfлон Ester Ultra)	G	G
quinclorac (Drive XLR8)	F-P	P

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- ### HERBICIDES WITH TRICLOPYR
- For best postemergence violet control use triclopyr containing products
 - Chaser
 - Momentum FX2
 - Turflon Ester Ultra
 - T-Zone
 - 4-Speed XT
 - Battleship III
 - CoolPower
 - HorsePower
 - Tailspin
 - Confront – not in residential turf



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- ### BEST HERBICIDES FOR VIOLETS
- For best post emergence control use
 - Triclopyr containing products
 - Chaser
 - Momentum FX2
 - **Turfлон Ester Ultra* (1.0 lb ae/A at high label rate)**
 - T-Zone
 - 4-Speed XT
 - Battleship III
 - CoolPower
 - HorsePower
 - **Tailspin* (0.75 lb ae/A at high label rate)**
 - Confront – not in residential turf
- Use the high label rate for violets

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- Turfлон Ester (triclopyr)
- | <u>Poor Control</u> | <u>Consistent Control</u> |
|---------------------|---------------------------|
| 1. Dandelion | 1. Ground ivy |
| 2. Common plantain | 2. Wild violet |
| 3. White clover | 3. Yellow woodsorrel |
| 4. Henbit | 4. Purslane |
| 5. Chickweeds | 5. Lespedeza |
| 6. Common mallow | 6. Thistles |



EFFICACY OF SYNTHETIC AUXIN HERBICIDES AGAINST BROADLEAF WEEDS

Herbicide	White clover	Dandelion	Common chickweed	Ground ivy	Wild violet	Yellow wood-sorrel
2,4-D	P	E	P	F	P	P
dichlorprop (2,4-DP)	P	P	G	P	P	P
MCPA	F	G	E	P	P	F
MCPP, mecoprop (Mecomec)	F	P	F	P	P	P
dicamba (Banvel, Vanquish)	E	P	E	P	P	P
clopyralid (Lontrel)	E	F	P	P	P	P
fluroxypyr (Vista XRT)	E	F	E	G	P	E
triclopyr (Turfion Ester Ultra)	F	P	P	G	G	E
quinclorac (Drive XLR8)	E	F	P	F-P	P	P

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- Covers which herbicides work best for each weed

Postemergence Herbicides

Weed Control Ratings for Postemergence Broadleaf Herbicides

Herbicide	Canada thistle	chickweed, common	chickweed, mosaic ear	clover, white	dandelion	garlic, wild (onion)	henbit	ground ivy	horseweed, purple-stem	leopard's bane	malva	plantain	purple deadnettle	purple, common	shepherd's purse	spotted tail, com	spring, purple-stem	strawberry, Indian mink	wild violet	yellow woodsorrel
2,4-D (Weedone 64, Weedone Ultra, others)	G	P	P	P	E	E	P	F	P	P	G	G	G	G	G	P	P	F	P	P
2,4-D + dicamba (On Deck)	G	P	E	G	E	G	E	F	G	P	G	G	G	E	G	P	G	F	P	P
2,4-D + dichlorprop (2,4-DP)	G	G	G	F	E	G	E	F	G	G	E	G	G	G	G	F	G	F	P	P
2,4-D + clopyralid + dicamba (Millennium Ultra 2)	E	G	E	E	E	E	G	E	F	G	G	G	G	G	G	P	G	F	P	P
2,4-D + dichlorprop + dicamba (Discusmax)	E	G	E	G	E	G	E	F	G	G	E	E	G	G	G		F		P	P
2,4-D + fluroxypyr + dicamba (Escalade 2)	E	G	E	G	E	G	E	G	E	G	G	G	E	G	P	G	F	F	P	E

and more

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SUMMARY

- Poor weed control often traces back to poor herbicide selection or poor weed identification
- Identifying your weeds and choosing the most effective herbicides can reduce the number of herbicide applications you make

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The image shows a screenshot of a Twitter profile for Aaron Patton (@PurdueTurfDoc). The profile picture is a headshot of Aaron Patton. The bio identifies him as a Turf & Weed Scientist at Purdue University, located in West Lafayette, IN, with a website link to turf.purdue.edu. He joined in April 2012, follows 248 people, and has 2,522 followers. A pinned tweet from February 17, 2018, is visible, titled "2018 Turfgrass Weed Control for Professionals now available. 13 state collaborators. Full color weed ID for 118 weeds. Updated throughout including a new use section by @URHort Qrdr". The tweet includes a link to a PDF document.