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Application Timing Influences Purple Nutsedge (*Cyperus rotundus*) and Yellow Nutsedge (*Cyperus esculentus*) Susceptibility to EPTC and Fomesafen

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Purple and yellow nutsedge are problematic weeds in Florida small fruit and vegetable production. EPTC and fomesafen are PRE herbicides that suppress both nutsedge species, but field application in Florida has shown control to be erratic. Greenhouse experiments were conducted in Gainesville, FL, from May to August 2014 and in Wimauma, FL, from March to May 2015 to investigate susceptibility of purple and yellow nutsedge to EPTC and fomesafen applications. Treatments included EPTC at 2.91 kg ai ha^{-1} and fomesafen at 0.42 kg ai ha^{-1} at 0, 3, 6, 9, 12, and 15 d after planting (DAP) tubers, plus a nontreated control. EPTC and fomesafen applications averaged across timings decreased purple and yellow nutsedge emergence, shoot height, leaf number, and shoot mass compared to the nontreated control. Herbicide applications 0 DAP reduced purple nutsedge emergence greater than 65% compared to the nontreated control and caused at least 74% injury 4 wk after planting. Herbicide applications 0 DAP decreased yellow nutsedge emergence and shoot mass compared to the nontreated control by at least 86 and 93%, respectively. Applications of EPTC and fomesafen have the ability to suppress short-term purple and yellow nutsedge growth. Applications made at or prior to tuber sprouting maximize herbicide efficacy.

Nomenclature: EPTC; fomesafen; purple nutsedge, *Cyperus rotundus* L.; yellow nutsedge, *Cyperus esculentus* L.

Key words: Plasticulture, preemergence herbicides.

Cyperus rotundus y *Cyperus esculentus* son malezas problemáticas en la producción de frutas pequeñas y vegetales en Florida. EPTC y fomesafen son herbicidas PRE que suprimen a ambas especies de *Cyperus*, pero su aplicación en campo ha mostrado un control errático en Florida. Se realizaron experimentos de campo en Gainesville, Florida, desde Mayo a Agosto 2014 y en Wimauma, Florida, desde Marzo a Mayo 2015, para investigar la susceptibilidad de *C. rotundus* y *C. esculentus* a aplicaciones de EPTC y fomesafen. Los tratamientos incluyeron EPTC a 2.91 kg ai ha^{-1} y fomesafen a 0.42 kg ai ha^{-1} a 0, 3, 6, 9, 12, y 15 d después de la siembra (DAP) de tubérculos, más un testigo sin tratamiento. Las aplicaciones de EPTC y fomesafen, promediando todos los momentos de aplicación, disminuyeron la emergencia, la altura de la parte aérea, el número de hojas, y la masa de la parte aérea de *C. rotundus* y *C. esculentus*, en comparación con el testigo sin tratamiento. Las aplicaciones 0 DAP redujeron la emergencia de *C. rotundus* en más de 65% al compararse con el testigo sin tratamiento y causaron al menos 74% de daño 4 semanas después de la siembra. Las aplicaciones de herbicidas 0 DAP disminuyeron la emergencia y la masa de la parte aérea de *C. esculentus* al compararse con el testigo sin tratamiento en al menos 86 y 93%, respectivamente. Las aplicaciones hechas al momento o antes del rebrote de los tubérculos maximiza la eficacia del herbicida.

Purple and yellow nutsedge are problematic weeds in Florida plasticulture production that can compete with the desired crop plant for light and nutrients. Motis et al. (2003) reported 10% pepper (*Capsicum annuum* L.) yield loss with fewer than five yellow nutsedge tubers planted per square metercompared to a weed-free control. Full interference by purple and yellow nutsedge reduced tomato (*Solanum lycopersicum* L.) shoot dry weight 34 and 28%, respectively (Morales-Payan et al.

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2003). Purple nutsedge densities of 126 plants m^{-2} at 10 wk after transplant resulted in 53 and 50% tomato fruit number and weight reductions, respectively, compared to fumigant treatments with less than 15 plants m^{-2} (Gilreath and Santos 2004). Season-long purple and yellow nutsedge competition can reduce pepper yield greater than 70% (Morales-Payan et al. 1998; Motis et al. 2004). Nutsedge density and competition timing affect the competitive relationship between nutsedge and horticultural crops (Motis et al. 2003; Morales-Payan et al. 2003).

Historically, fruit and vegetable growers in Florida have relied on methyl bromide as the foundation for weed, nematode, and soilborne pathogen management (Chandler et al. 2001; Noling and Becker 1994). However, methyl bromide was classified as an ozone-depleting substance under the provisions of the Montreal Protocol and its use is now prohibited in all fruit and vegetable crops in Florida. Many alternative fumigants have been registered that control or suppress nutsedge (McAvoy and Freeman 2013a, b). However, alternative fumigants are not as effective on nutsedge as methyl bromide. Gilreath and Santos (2005) noted a five- to sevenfold greater purple nutsedge density in plots not treated with methyl bromide compared to where methyl bromide was applied. Florida growers have reported an increase in nutsedge density following the loss of methyl bromide and poor or inconsistent nutsedge control with alternative fumigants (Snodgrass et al. 2011). These observations were supported by a trial conducted by Jacoby (2012) at the University of Florida that evaluated alternative fumigants and found that nutsedge density increased over 3 yr in all treatments, suggesting that supplementary measures such as the use of PRE herbicides are necessary to effectively control nutsedge.

Several PRE herbicides with activity on nutsedge, including EPTC and fomesafen, have been registered for use in tomato production in Florida and have potential for use in other high-value crops such as strawberry (*Fragaria* × *ananassa*), but have not been widely adopted because of inconsistent efficacy and concern over crop tolerance. EPTC is a thiocarbamate herbicide that inhibits cuticle formation at the early stages of germination with most susceptible plants failing to emerge (Fuerst 1987; Shaner 2014). EPTC can suppress growth and delay emergence of both purple and yellow nutsedge. For example, EPTC at 4.48 kg ai ha^{-1} reduced purple nutsedge tuber sprouting 44% 2 wk after treatment (Holt et al. 1962). EPTC at 3.36 kg ha^{-1} reduced yellow nutsedge tuber production 66% and shoot weight 29% from a nontreated control 12 wk after treatment (Keeley and Thullen 1974).

Fomesafen is a diphenylether herbicide that inhibits the protoporphyrinogen oxidase enzyme (Protox) that catalyzes the conversion of protoporphyrinogen IX to protoporphyrin IX as part of the tetrapyrrole biosynthesis pathway (Duke et al. 1991; Scalla and Matringe 1994). Protox inhibitors cause a rapid buildup of substrates that when in the presence of light, lead to lipid peroxidation, resulting in cell death (Becerril and Duke 1989; Scalla and Matringe 1994). Leaf chlorosis, necrosis, and desiccation are symptoms of plants susceptible to fomesafen (Shaner 2014). Fomesafen applied PRE can suppress or control yellow nutsedge growth. In open-field cotton production, soil-applied herbicide programs containing fomesafen controlled yellow nutsedge greater than 90% (Wilcut et al. 1997). In plasticulture production, drip-applied fomesafen at 0.28 kg ai ha^{-1} reduced yellow nutsedge punctures of mulch 89%, 56 d after treatment (Monday et al. 2015). Variable fomesafen efficacy on purple nutsedge has been demonstrated by previous research. Miller and Dittmar (2014) found that PRE applications of fomesafen at 0.42 kg ha^{-1} controlled 48 to 50% of purple and yellow nutsedge mix 28 d after treatment, with 52% nutsedge control at 11 wk after treatment. Boyd (2015) reported fomesafen application alone did not reduce purple nutsedge populations, but a fomesafen plus *S*-metolachlor tank-mix reduced purple nutsedge counts by 84% in 1 yr.

PRE herbicides used in combination with alternative fumigants may facilitate season-long weed control in plasticulture production. However, it is important to note that field preparation can break up tuber dormancy and stimulate nutsedge growth (Alves et al. 2013; Taylorson 1967). The time frame from soil preparation to fumigation and herbicide application may affect nutsedge growth and subsequently herbicide efficacy. Understanding the interaction between nutsedge growth and herbicide activity is essential to optimize efficacy. The objective of this study was to investigate the influence of application timing on efficacy of EPTC and fomesafen for purple and yellow nutsedge control.

Material and Methods

Purple Nutsedge. Two greenhouse experiments were conducted at the University of Florida in Gainesville, FL (29.64°N, 82.36°W), from May to August 2014, to investigate purple nutsedge tuber growth stage susceptibility to EPTC and fomesafen applications. Purple nutsedge tubers and field soil were gathered at the University of Florida Plant Science Research and Education Unit, Citra, FL (29.40°N, 82.18°W). Five nonsprouted purple nutsedge tubers selected for similar size per replication were planted in field soil (Hague series sand; loamy, siliceous, semiactive, hyperthermic Arenic Hapludalfs) with 1.4% organic matter and a pH of 5.8. Tubers were planted at a depth of 2.5 to 5.0 cm in plastic pots with 110.3-cm^2 surface area by 12.0-cm depth in a temperature controlled greenhouse set for 32/25 C day/night temperatures.

Experimental design was a randomized complete block with 10 blocks. Treatments included EPTC (Eptam 7E Selective Herbicide, Gowan Company, Yuma, AZ) at 2.91 kg ai ha^{-1} and fomesafen (Reflex 2L Liquid Herbicide, Syngenta Crop Protection, LLC, Greensboro, NC) at 0.42 kg ha^{-1} at six different timings, plus a nontreated check. Application timings were spread 3 d apart and were 0, 3, 6, 9, 12, and 15 d after planting (DAP). The rates for EPTC and fomesafen are currently labeled for use in Florida tomato production. Treatments were applied within a spray chamber (Generation III Research Sprayer, DeVries Manufacturing, Hollandale, MN) calibrated to deliver 187 L ha^{-1}. Herbicides were incorporated with 1.3 cm rainfall equivalent with overhead irrigation over 0.5 h. Pots were visually monitored and watered as needed to prevent soil moisture deficiencies.

Yellow Nutsedge. Two greenhouse experiments were conducted at the University of Florida Gulf Coast Research and Education Center in Wimauma, FL (27.76°N, 82.23°W), from March to May 2015, to investigate yellow nutsedge tuber growth stage susceptibility to EPTC and fomesafen applications. Five nonsprouted yellow nutsedge tubers (JB Natural Foods S.L., Puzol, Valencia, Spain) selected for similar size per replication were planted in field soil (Myakka series fine sand; sandy, siliceous, hyperthermic Aeric Alaquods) with 0.8% organic matter and a pH of 7.6 gathered at Gulf Coast Research and Education Center. Tubers were planted at a depth of 2.5 to 5.0 cm in 110.3-cm^2 surface area by 9.0-cm-deep plastic pots in a greenhouse that averaged approximately 27/20 C day/night temperatures across experiments as monitored by HOBO Pro v2 data logger (Onset Computer Corporation, Bourne, MA).

Experimental design was a randomized complete block with five blocks. Treatments were the same for the yellow nutsedge experiment as previously stated in purple nutsedge experiment. However, herbicides were applied with a CO_2-pressured backpack sprayer calibrated to deliver 187 L ha^{-1} with a single DG 9502 EVS flat-fan nozzle (TeeJet, Spraying Systems Co., Wheaton, IL). Herbicides were incorporated with 1.3 cm rainfall equivalent with overhead irrigation over 0.5 h and pots were watered as needed, throughout the experiment.

Data Collection. At each application, 10 and 5 additional nontreated pots with five tubers each were harvested for purple and yellow nutsedge, respectively. Sprouted shoot number and shoot length from tuber data was taken to indicate nutsedge above and below soil surface development at time of application. Rhizomes elongated from tuber to any subsequent growth stage are defined as shoots in the experiments. Shoot length includes rhizomatous growth from tuber to the tallest leaf tip.

For all treatments, emergence, shoot height, leaf number, and injury was evaluated at 4 wk after planting (WAP). Shoot height was measured from the soil surface to tip of tallest leaf of each shoot. Injury was evaluated on a 0 to 100% scale where 0 equals no visible chlorosis or stunting and 100 equals no emergence or complete necrosis. For each pot, tubers and plant shoots at the soil surface were harvested at 4 WAP. All tuber and plant shoots were then oven-dried at 60 C for 48 h for purple nutsedge and at 40 C for 72 h for yellow nutsedge to determine dry weights. Tubers harvested at application timings were also dried and weighed using the same methodology for each species.

Statistical Analysis. Data were subjected to ANOVA at the 0.05 probability level in SAS (SAS® Institute v. 9.4, Cary, NC) using the mixed procedure with block as the random factor. Data

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Table 1. Purple and yellow nutsedge shoot number per pot and average shoot length when herbicides were applied in two combined greenhouse experiments for purple and yellow nutsedge, in Gainesville, FL, in 2014 and Wimauma, FL, in 2015, respectively.

	Purple nutsedge		Yellow nutsedge	
Application timing (DAP[a])	Shoots	Shoot length	Shoots	Shoot length
	no. pot^{-1}	cm shoot^{-1}	no. pot^{-1}	cm shoot^{-1}
0[b]				
3	1 a	1.8 a	1 a	0.3
6	2 b	4.4 ab	1 ab	1.5
9	2 b	5.0 ab	2 ab	1.9
12	2 b	7.1 b	3 bc	2.9
15	3 b	11.3 c	4 c	7.5
P value	< 0.0001	< 0.0001	< 0.0001	0.1453

[a] Abbreviation: DAP, days after planting.

[b] Application at 0 DAP had zero shoots and was excluded from the model due to variance of zero for shoot number and shoot length conflicting with model assumption of constant variance.

[c] Means within columns followed by different letters are significantly different at $P < 0.05$ using Tukey adjusted means comparisons.

were checked for normality and constant variance prior to analysis. Purple and yellow nutsedge were analyzed separately as trials for each species were conducted at different locations and timings. Means were compared using the least squares means statement with the Tukey adjustment and orthogonal contrasts were performed to compare nontreated to each herbicide and herbicides to one another. In all analyses, significance was determined at the $P \leq 0.05$ level. Experiment by treatment interactions were not detected and, thus, experiments were combined for each species.

Results and Discussion

Purple Nutsedge. Purple nutsedge shoot number and length increased with application time from day of planting (Table 1). Applications at 0 to 3 DAP had half or fewer shoots than later timings. Shoot number did not significantly increase after 6 DAP. Shoot length increased approximately fourfold from 3 DAP to 12 DAP. Tubers harvested at applications were similar and weighed 1.59 ± 0.04 g across all timings. Temperatures were in an appropriate range for tuber sprouting with diurnally alternating temperatures from 32 to 27 C (Miles et al. 1996; Nishimoto 2001). However, three sprouted shoots per five tubers by 15 DAP is less than the 92% maximum sprouting reported by Wallace et al. (2013) under similar conditions from tubers collected in Georgia. Weed growth stage and density can affect herbicide efficacy, and the lack of purple nutsedge growth due to greater tuber dormancy may have led to increased short-term EPTC and fomesafen activity compared to previous studies (Lati et al. 2012; Pires da Silva et al. 2014; Wang 2002).

Orthogonal contrasts indicate EPTC and fomesafen applications averaged across all timings decreased purple nutsedge emergence, shoot height, leaf number, and dry shoot mass compared to the nontreated control (Table 2). The two herbicides similarly affected purple nutsedge emergence and caused comparable injury. EPTC applications appear to decrease average shoot height, leaf number, and dry shoot mass to a greater extent than fomesafen treatments. Short-term suppression of purple nutsedge by EPTC and fomesafen has been previously observed (Holt et al. 1962; Miller and Dittmar 2014). However, Boyd (2015) reported EPTC at 2.29 kg ha^{-1} and fomesafen at 0.42 kg ha^{-1} applications had no effect on season-long purple nutsedge density compared to nontreated control in tomato production.

EPTC and fomesafen applications made on the day of planting reduced emergence, shoot height, leaf number, and shoot mass at least 67, 48, 20, and 79%, respectively, from the nontreated control at 4 WAP, and caused greater than 70% injury. EPTC treatments made 9 DAP or earlier reduced both average shoot height and leaf number compared to the nontreated control, whereas only fomesafen applications at 3 DAP or earlier had a reduction. All applications except fomesafen at 15 DAP reduced

Table 2. Purple nutsedge average emergence per pot, shoot height, leaf number, dry shoot mass per pot, and injury 4 wk after planting from EPTC and fomesafen applications at six timings in two combined greenhouse experiments, 2014, Gainesville, FL.

Herbicide[a]	Application (DAP[b])	Purple nutsedge (4 WAP)				
		Emergence	Shoot height	Leaf number	Shoot mass	Injury
		no. pot^{-1}	cm shoot^{-1}	no. shoot^{-1}	g pot^{-1}	%
Nontreated control		3 a[c]	19.8 a	5 a	0.077 a	
EPTC	0	0 d	6.5 cd	3 c	0.004 e	94 a
	3	1 cd	5.7 d	3 c	0.008 de	77 ab
	6	2 abc	6.3 cd	3 c	0.012 de	63 abc
	9	2 abc	10.2 bcd	4 bc	0.017 cde	37 cde
	12	2 abc	10.7 abc	4 bc	0.029 cde	24 de
	15	2 abc	13.9 ab	4 abc	0.034 bcd	14 e
Fomesafen	0	1 bcd	10.3 bcd	4 bc	0.016 cde	74 ab
	3	2 abc	10.3 bcd	4 bc	0.020 cde	57 bc
	6	2 abc	12.2 ab	4 abc	0.020 cde	49 bcd
	9	2 abc	13.1 ab	5 ab	0.044 bc	37 cde
	12	2 abc	12.7 ab	5 a	0.033 bcde	34 cde
	15	2 ab	13.3 ab	5 a	0.058 ab	18 de
Contrasts						
EPTC vs. fomesafen[d]		0.4059	0.0028	< 0.0001	< 0.0001	0.1078
Nontreated control vs. EPTC[e]		0.0070	< 0.0001	< 0.0001	< 0.0001	
Nontreated control vs. fomesafen[f]		0.0238	0.0365	0.0128	< 0.0001	

[a] Products applied were Eptam 7E Selective Herbicide (EPTC), Gowan Company, Yuma, AZ, at 2.94 kg ai ha^{-1} and Reflex 2L Liquid Herbicide (fomesafen), Syngenta Crop Protection, LLC, Greensboro, NC, at 0.42 kg ai ha^{-1}.

[b] Abbreviations: DAP, days after planting;WAP, weeks after planting.

[c] Means within columns followed by different letters are significantly different at $P < 0.05$ using Tukey adjusted means comparisons.

[d] This contrast compares the mean of all treatments with EPTC vs. the mean of all treatments with fomesafen.

[e] This contrast compares the nontreated control vs. the mean of all treatments with EPTC.

[f] This contrast compares the nontreated control vs. the mean of all treatments with fomesafen.

shoot biomass. Purple nutsedge emergence, shoot height, leaf number, and shoot mass tended to increase with herbicide application time from day of planting and injury tended to decrease, although the differences were not always significant at 4 WAP. The more time allowed for nutsedge growth to time of application can significantly affect efficacy. EPTC and fomesafen treatments at 0 DAP had greater than 70% dry shoot mass reduction compared to equivalent treatments made at 15 DAP. However, tuber dry weights per pot were similar and averaged 1.49 ± 0.03 g across all treatments.

EPTC and fomesafen are most effective on purple nutsedge when applied at early sprouting. Previous research has demonstrated early purple nutsedge sprouting to be susceptible to herbicide application (Wang 2002). Fishler et al. (1995) reported purple nutsedge was sensitive to benfuresate incorporated in soil up to 8 d after initiation of tuber sprouting, whereas older shoots recovered from herbicide injury. Practices that enhance EPTC and fomesafen contact with purple nutsedge during early shoot growth may increase herbicide activity and improve consistency.

Yellow Nutsedge. Yellow nutsedge shoot number increased with application time from day of planting (Table 1). Yellow nutsedge growth appears to accelerate considerably from 1 to 2 WAP with shoot number quadrupling from 6 to 15 DAP. Average shoot length was similar across all application timings. Tubers harvested at applications had similar weights averaging 2.12 ± 0.05 g across all timings.

Herbicide applications across all timings reduced yellow nutsedge growth compared to the nontreated (Table 3). EPTC and fomesafen comparably affected yellow nutsedge emergence, shoot height, leaf number, and shoot mass, and caused similar injury. EPTC and fomesafen have demonstrated short-term control of yellow nutsedge. Keeley and

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Table 3. Yellow nutsedge average emergence per pot, shoot height, leaf number, dry shoot mass per pot, and injury 4 wk after planting from EPTC and fomesafen applications at six timings in two combined greenhouse experiments, 2014, Gainesville, FL

		Yellow nutsedge (4 WAP)				
Herbicide[a]	Application (DAP[b])	Emergence	Shoot height	Leaf number	Shoot mass	Injury
		no. pot^{-1}	cm shoot^{-1}	no. shoot^{-1}	g pot^{-1}	%
Nontreated Control		7 a[c]	16.6 a	6 a	0.57 a	
EPTC	0	1 d	8.3 ab	4 ab	0.04 c	80 ab
	3	2 cd	8.3 ab	5 ab	0.05 c	74 ab
	6	2 bcd	9.0 ab	4 ab	0.05 c	72 ab
	9	4 abcd	9.4 ab	4 ab	0.15 bc	51 abcd
	12	5 abc	10.7 ab	5 a	0.17 bc	49 abcd
	15	5 ab	15.9 ab	5 a	0.31 abc	14 cd
Fomesafen	0	1 d	7.1 b	3 b	0.03 c	88 a
	3	2 bcd	7.0 b	4 ab	0.05 c	77 ab
	6	3 bcd	9.2 ab	5 ab	0.10 c	66 ab
	9	5 abcd	11.3 ab	5 ab	0.12 c	54 abc
	12	5 ab	11.0 ab	5 a	0.24 abc	43 bcd
	15	6 a	12.1 ab	5 a	0.47 ab	13 d
Contrasts						
EPTC vs. fomesafen[d]		0.1139	0.5510	0.6010	0.3240	0.9596
Nontreated control vs. EPTC[e]		< 0.0001	0.0007	0.0098	< 0.0001	
Nontreated control vs. fomesafen[f]		0.0013	0.0002	0.0035	< 0.0001	

[a] Products applied were Eptam 7E Selective Herbicide (EPTC), Gowan Company, Yuma, AZ, at 2.94 kg ai ha^{-1} and Reflex 2L Liquid Herbicide (fomesafen), Syngenta Crop Protection, LLC, Greensboro, NC, at 0.42 kg ai ha^{-1}.

[b] Abbreviations: DAP, days after planting;WAP, weeks after planting.

[c] Means within columns followed by different letters are significantly different at $p<0.05$ using Tukey adjusted means comparisons.

[d] This contrast compares the mean of all treatments with EPTC vs. the mean of all treatments with fomesafen.

[e] This contrast compares the nontreated control vs. the mean of all treatments with EPTC.

[f] This contrast compares the nontreated control vs. the mean of all treatments with fomesafen.

Thullen (1974) reported applications of EPTC at 3.36 kg ai ha^{-1} on the day of planting reduced nutsedge emergence 93% at 4 wk after treatment and fresh shoot mass 97% at 6 wk after treatment. Grichar (1992) reported 99% control of yellow nutsedge in open-field peanut (*Arachis hypogaea* L.) production at 20 d after application of fomesafen at 0.43 kg ha^{-1}. Monday et al. (2015) observed that fomesafen at 0.28 kg ha^{-1} reduce yellow nutsedge punctures in plastic mulch 80% at 28 d after treatment.

EPTC and fomesafen efficacy on yellow nutsedge appears to increase with applications made within the first week of planting. Herbicide applications made 6 DAP or earlier reduced emergence and shoot mass at least 57 and 82%, respectively, from the nontreated, and caused greater than 65% injury. Fomesafen application made 0 DAP was the only treatment to reduce average shoot height and leaf number from the nontreated. Harvested tubers at 4 WAP had similar fresh and dry weights to nontreated across all timings. Each pot of five tubers had similar dry weights of 1.98 ± 0.03 g across all treatments. At 4 WAP, yellow nutsedge emergence, shoot height, leaf number, and shoot mass tended to increase with application time from day of planting and injury tended to decrease, although the differences were not always significant. EPTC treatments at 0 and 3 DAP had less than half as much emergence and more than five times the amount of injury than corresponding treatment at 15 DAP. Fomesafen applications made 6 DAP or earlier had at least a 50 and 78% reduction in emergence and shoot mass, respectively, from fomesafen treatment made 15 DAP. Nutsedge tolerance to EPTC and fomesafen increases with plant age. It has been documented that thiocarbamate and diphenylether herbicides most effectively suppress yellow nutsedge when applied during early growth stages and are capable of reducing tuber and shoot production; however, there is no evidence of the herbicides terminating tubers (Felix and New-

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berry 2012; Keeley and Thullen 1974; Pereira and Crabtree 1986; Pereira et al. 1987). Applying EPTC and fomesafen when the herbicides can effectively control yellow nutsedge is critical for successful long-term suppression.

Early applications of EPTC and fomesafen have demonstrated the ability to suppress short-term purple and yellow nutsedge growth. The results suggest that increased efficacy will occur when herbicides are applied as closely to tuber sprouting as possible. The herbicides appear to have potential as part of a weed management program for growers to complement fumigants for PRE nutsedge control. Further research on efficacy of these herbicides with greater nutsedge pressure and length of experimentation in plasticulture setting is necessary before recommending EPTC and fomesafen for purple and yellow nutsedge suppression.

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