Smellmelon Control and Peanut Response to Flumioxazin and Paraquat Alone and in Combination

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ABSTRACT

Field studies were conducted in the Texas High Plains and south Texas to determine peanut response to flumioxazin and paraquat applied preemergence or 7 days after ground cracking (DAC). These herbicides were applied either alone or in combination. Smellmelon control was greater than 90% with all 7 DAC treatments while preemergence (PRE) treatments of flumioxazin plus paraquat controlled 87 to 97% in one of two years. No peanut injury was noted following either herbicide applied preemergence; however, early-season injury (stunting and leaf chlorosis/necrosis) was evident with flumioxazin and paraquat alone or in combination when applied 7 DAC. Early-season injury in south Texas from the 7 DAC applications of flumioxazin and paraquat varied from 9 to 63% with flumioxazin alone, 18 to 65% with paraquat alone, and 33 to 83% with combinations of the two herbicides. Injury in the Texas High Plains was never more than 40% with either herbicide alone or in combination. Mid-season injury in south Texas was at least 13% with any combination that included flumioxazin at 0.11 kg/ha while injury in the Texas High Plains varied from 12 to 25%. Peanut yields were not affected by flumioxazin and paraquat in the High Plains area although yields in south Texas were reduced from the untreated weed-free check with combinations of flumioxazin and paraquat.

Key Words: Peanut leaf necrosis, stunting, yield.

Peanut (*Arachis hypogaea* L.) has several unique features that contribute to challenging weed management. Peanut cultivars grown in the United States require a fairly long growing season (140 to 160 d), depending on cultivar and geographical region (Henning *et al.*, 1982; Wilcut *et al.*, 1995). Peanut also has a prostrate growth habit, a relatively shallow canopy, and is slow to shade inter-rows allowing weeds to be more competitive (Walker *et al.*, 1989; Wilcut *et al.*, 1995). Consequently, soil-applied herbicides may not provide season-long control and mid-to-late season weed pressure can occur. Additionally, peanut fruit develops underground on pegs originating from branches that grow along the soil surface. This prostrate growth habit and pattern of fruit development restricts cultivation to an early season control option (Brecke and Colvin, 1991; Wilcut *et al.*, 1995). With conventional row spacing (91 to 102 cm), complete ground cover may not be attained until 8 to 10 wk after planting. In some areas of the United States peanut growing region, complete canopy closure may never occur.

Paraquat is one of the most frequently used postemergence (POST) herbicides in Southeastern United States peanut production systems but is seldom used in the Southwestern production region because crop injury may occur, reducing yield and grade characteristics (Knauft *et al.*, 1990; Wilcut and Swann, 1990). The addition of bentazon to paraquat is a common practice to reduce peanut injury, although it may be either antagonistic or synergistic on weed control depending on the weed species and herbicide rate (Wehtje *et al.*, 1992) and often does not improve peanut yield despite the reduction in crop injury (Wehtje *et al.*, 1986, 1992; Wilcut *et al.*, 1989). Due to the low price of paraquat, growers in the southwest continue to express an interest in its use (authors' personal observations). However, concerns have been expressed about peanut cultivar response to paraquat applications. Evaluations of cultivar response to herbicide treatments containing paraquat have been studied (Knauft *et al.*, 1990; Wehtje *et al.*, 1991; Wilcut and Swann, 1990).

Flumioxazin is a *N*-phenyl phthalamide soil-applied herbicide that received a federal label in the United States for use in peanut in 2001 (Grichar *et al.*, 2004). Flumioxazin inhibits the enzyme protoporphyrinogen oxidase (Anderson *et al.*, 1994; Senseman, 2007; Yoshida *et al.*, 1991). In Georgia, flumioxazin applied preemergence (PRE) was shown to control morningglory spp. (*Ipomoea* spp.), prickly sida (*Sida spinosa* L.), and Florida beggarweed (*Desmodium tortuosum* (Sw.) DC) (Wilcut, 1997) while in Texas, pitted morningglory [*Ipomoea lacunosa* L.] were controlled greater than 75% (Grichar and Colburn, 1996). Flumioxazin has been reported to cause peanut injury especially when the application is delayed until peanut

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emergence (Johnson *et al.*, 2006; Jordan *et al.*, 2009; Tredaway-Ducar *et al.*, 2009). When applied soon after peanut planting (1 to 2 d), Grichar *et al.* (2004) reported that flumioxazin plus metolachlor combinations, under cool, wet conditions resulted in peanut stunting which was evident throughout the growing season. They attributed this to increased uptake of flumioxazin and metolachlor with the heavy rainfall and the slowed metabolism of these herbicides as a result of cool temperatures (Yoshida *et al.*, 1991). Askew *et al.* (1999) reported that flumioxazin at 0.07 and 0.11 kg ai/ha injured peanut 45 and 62%, respectively, when evaluated 2 wks after peanut planting. Peanut stunting of greater than 60% was followed by as much as 35% leaflet discoloration, which was characterized as necrotic spots on foliage. Scott *et al.* (2001) reported that flumioxazin treated peanuts were injured 10% when evaluated 3 wks after planting. However, injury was transient and was not appartent 6 wk after planting. Flumioxazin enters plants mainly by shoot and root uptake, and plant injury can be avoided via rapid metabolism (Yoshida *et al.*, 1991; Anderson *et al.*, 1994).

Smellmelon is becoming more of a problem in south Texas peanut production fields and has become a problem in several crops along the Texas Gulf coast (author's personal observation). The range of smellmelon stretches from Georgia to the southern part of California and as for north as Arkansas (SWSS, 1999). Smellmelon can be a problem at peanut harvest as the melon can become broken apart when run through the combine and increase drying time because of the high moisture content of the melon itself (author's personal observation). In IMI-tolerant corn (*Zea mays* L.), Thompson *et al.* (2005) reported that imazapic at 0.07 and 0.14 kg ai/ha applied either PRE, early POST, or late POST controlled smellmelon greater than 90%. Tingle and Chandler (2004) reported that smellmelon control was at least 93% with low-, medium-, and high-input herbicide systems. In cotton (*Gossypium hirsutum* L.), glyphosate systems have provided effective smellmelon control (Livingston *et al.*, 2004; Livingston, 2006). Tingle *et* al. (2000) reported when smellmelon was allowed to compete with cotton for at least 6 wks, yield was reduced 7% compared to the weed-free check but when smellmelon was allowed to compete for 10 to 12 wks, cotton yield was reduced 22 and 27%, respectively.

Some growers in the southwest have questioned the feasibility of applying flumioxazin and paraquat at planting or soon after peanut emergence to control weeds that are not normally controlled with either herbicide alone and response of peanut cultivars to these herbicides and application timing. The product label states that PRE applications of flumioxazin must be made within 2 d after planting and prior to peanut emergence. Application after the peanut have begun to crack, or are emerged, will result in severe crop injury (Anonymous, 2009). Although off-label with respect to flumioxazin, the objective of this research was to evaluate the effect of flumioxazin and paraquat alone and in combination applied PRE or after peanut cracking for smellmelon (*Cucumis melo* L. var. *Dudaim* Naud.) control and peanut response.

Materials and Methods

Smellmelon control and peanut tolerance studies were conducted in south Texas near Yoakum and in the Texas High Plains near Lamesa and Halfway with runner and Spanish market-types during the 2009 through 2011 growing seasons. The studies in south Texas in 2009 and 2010 were conducted in areas with high populations of smellmelon while the study in 2011 and at the High Plains locations in 2009 and 2010 were conducted under weed-free conditions. The soils at Yoakum were a Denhawken sandy clay loam (fine, smectitic, hyperthermic, Vertic Haplustepts, 1.6% organic matter, pH 7.6); at Lamesa the soils were a Amarillo fine sandy loam (fine-loamy, mixed, superactive, thermic Aridic Paleustalf, 0.4% organic matter, pH 7.8); and at Halfway the soils were a Acuff sandy clay loam (fine-loamy, mixed, superactive thermic Aridic Paleustolls) with $<$ 0.8% organic matter and pH 7.7. Planting date, application dates, and other variables for each study are given in Table 1.

Treatments consisted of a factorial arrangement of two application timings (PRE and 7 days after peanut cracking [DAC]) and 8 herbicide treatments. Herbicide treatments included flumioxazin alone at 0.07 and 0.11 kg ai/ha, paraquat alone at 0.14 and 0.28 kg ai/ha, flumioxazin at 0.07 kg/ha plus paraquat at 0.14 or 0.28 kg/ha, and flumioxazin at 0.11 kg/ha plus paraquat at 0.14 or 0.28 kg/ha. An untreated check was also included for comparison.

Plot size was two rows (97 cm apart) by 9.5 m. at Yoakum and four rows (101 cm apart) by 7.3 m. at Lamesa and Halfway and the two middle rows per plot were sprayed and the other rows were left untreated to serve as buffers. All PRE applications of herbicide treatments including paraquat and all 7 DAC treatments included a non-ionic surfactant, Induce® [non-ionic surfactant, a blend of alkylarylpolyoxyalkane ether, free fatty acids, and isopropyl (90%), and water and formulation acids (10%); Helena Chemical Co., 225 Schilling Boulevard,

Table 1. Variables for studies conducted in Texas from 2009 through 2011.

	Lamesa		Halfway	Yoakum		
Herbicide application	2009	2010	2011	2009	2010	2011
PRE	Apr 30	Apr 30	May 11	July 1	June 2	May 25
7 DAC	May 11	May 12	May 25	July 15	June 15	June 7
Planting date	Apr 30	Apr 28	May 10	June 30	June 1	May 25
Variety	Tamrun OL02	FL 458	OLin.	Tamrun OL02	Florida 07	Tamrun OL07
Weeds present	Weed-free	Weed-free	Weed-free	*Cucumis melo*	*Cucumis melo*	Weed-free

Suite 300, Collierville, TN 38017] in south Texas or R-11® (90% akylphenol ethoxylate, butyl alcohol dimethylpolysiloxane; Wilbur-Ellis Company, P.O. Box 16458, Fresno, CA 93755) in the High Plains area at the rate of 0.25% v/v. Herbicides were applied in water using a CO_2- pressurized backpack sprayer with TeeJet® 11002 DG (Spraying Systems Company, P.O. Box 7900, North Avenue, Wheaton, IL 60188) nozzles calibrated to deliver 190 L/ha at 180 kPa at Yoakum and TurboTee® 110015 nozzles calibrated to deliver 140 L/ha at 207 kPa at the Lubbock location.

Runner market-type peanut varieties 'Tamrun OL02' (Simpson *et al.*, 2006) in 2009, 'Florida 07' (Gorbet and Tillman, 2009) in 2010 and 'Tamrun OL07 (Baring et al., 2006) in 2011 were planted at Yoakum while at the High Plains locations, Tamrun OL02 was planted in 2009 and FlavorRunner 458 (Beasley and Baldwin 2009) was planted in 2010 at Lamesa. At the Halfway location the Spanish peanut OLin (Simpson et al., 2003) was planted.

Supplemental irrigation was supplied as needed at both locations. Traditional production practices were used to maintain peanut growth, development, and yield. In the weed-free studies, all plots received a dinitroaniline herbicide applied preplant incorporated and were cultivated and hand-weeded throughout the growing season to maintain weed-free conditions. Clethodim at 0.18 kg ai/ha + crop oil concentrate (COC) was applied POST to control annual grass escapes at the south Texas location. No insecticides were needed at any location in any year.

Peanut stunting was evaluated approximately 60 d after peanut planting with the runner peanuts cultivars in south Texas and the High Plains area, while the Spanish cultivars were rated prior to peanut digging. Peanut stunting were based on a scale of 0 (no peanut stunting) to 100 (peanut death). Peanut yield was determined by inverting the pods based on maturity of untreated control plots, air-drying in the field for 6 to 10 d, and harvesting individual plots with a combine. Yield samples were cleaned and adjusted to 10% moisture. For grades, a 200-g pod sample from each plot was obtained and grades determined following procedures described by the Federal-State Inspection Service (USDA, 1993).

Data for percentage of peanut injury and stunting were transformed to the arcsine square root prior to analysis; however, nontransformed means are presented because arscine transformation did not affect interpretation of the data. Data were subjected to ANOVA and analyzed using SAS PROC MIXED (SAS 2002). Treatment means were separated using Fisher's Protected LSD at $P \leq 0.05$. The untreated check was used for peanut yield and grade calculation comparison and a visual comparison for peanut injury and was only included in yield and grade analysis.

Results and Discussion

Smellmelon control. There was a treatment by year interaction for smellmelon control; therefore, that data were presented separately by year. In 2009, PRE applications of flumioxazin with/without paraquat failed to control smellmelon (≤ 53%) while flumioxazin or paraquat alone or in combination controlled smellmelon at least 92% when applied 7 DAC (Table 2). In 2010, flumioxazin alone applied PRE at 0.07 kg/ha controlled smellmelon 77% while flumioxazin at 0.11 kg/ha controlled 96% smellmelon. The addition of paraquat to flumioxazin PRE controlled smellmelon 87 to 97% while all flumioxazin or paraquat treatments alone or in combination applied 7 DAC controlled smellmelon at least 97% (Table 2). Effective control of smellmelon may be attributed to the amount of flumioxazin absorbed. Price *et al.* (2004) reported that the total ^{14}C-flumioxazin absorbed by ivyleaf morningglory (*Ipomoea hederacea* Jacq) was 57% of applied while sicklepod (*Senna obtusifolia* L.) absorbed 46% when evaluated 72 h after application and that a majority of this remained in the roots.

Early-season peanut injury. Since different peanut cultivars were used in each year of the study no attempt was made to combined peanut injury data over years. No peanut injury was observed with any PRE applications either in south Texas or the Texas High Plains (data not shown).

Table 2. Smellmelon control in south Texas as influence by flumioxazin and paraquat.

Herbicide		2009[a]		2010	
Flumioxazin	Paraquat	PRE[b]	7DAC	PRE	7DAC
kg ai/ha		%			
0	0	0	0	0	0
0.07	0	35	96	77	97
0.11	0	47	99	96	100
0	0.14	0	92	43	100
0	0.28	0	92	57	98
0.07	0.14	53	98	97	100
0.11	0.14	38	100	90	97
0.07	0.28	34	99	87	99
0.11	0.28	46	99	92	98
LSD (0.05)		37		30	

[a]Ratings for 2009, 50 DAP; 2010, 48 DAP.
[b]Abbreviations: PRE, preemergence; DAC, days after peanut cracking; DAP, days after planting.

Peanut injury from the 7 DAC treatments consisted of peanut stunting, leaf chlorosis and necrosis, and leaf bronzing that is typical of flumioxazin and paraquat injury (Grichar *et al.*, 2004; Wehtje *et al.*, 1992; Wilcut *et al.*, 1995; Johnson *et al.*, 2006). At Lamesa in 2009, flumioxazin alone applied 7 DAC resulted in 25 to 35% peanut injury depending on rate while combinations of flumioxazin plus paraquat resulted in 27 to 40% injury and this injury increased as the rate of flumioxazin increased regardless of paraquat rate (Table 3). In 2010 at Lamesa, 7 DAC applications of flumioxazin alone or flumioxazin plus paraquat caused at least 18% injury. No injury was observed with paraquat alone. In 2011 at Halfway, peanut injury with flumioxazin at 0.07 kg/ha was no different from the untreated check. Flumioxazin at 0.11 kg/ha plus paraquat at 0.14 kg/ha resulted in 15% peanut injury which was greater than flumioxazin alone, paraquat at 0.14 kg/ha, or a combination of flumioxazin at 0.07 kg/ha plus paraquat at 0.14 kg/ha.

At Yoakum in 2009, flumioxazin or paraquat alone and combinations of flumioxazin plus paraquat resulted in at least 53% peanut injury with the exception of paraquat alone at 0.14 kg/ha which resulted in 25% injury (Table 3). In 2010, peanut injury with flumioxazin alone was no different than the untreated check while paraquat alone at 0.14 kg/ha or flumioxazin at 0.07 kg/ha plus paraquat at 0.14 kg/ha caused 30 and 33% injury which was less than combinations that included paraquat at 0.28 kg/ha. In 2011, all herbicides caused peanut injury which was greater than the untreated check with the greatest injury observed with combinations that included paraquat at 0.28 kg/ha.

Mid-season peanut injury. As observed with the early-season peanut injury, PRE herbicide treatments resulted in no peanut injury in either area (data not shown). Mid-season injury from the 7 DAC treatments consisted of peanut stunting and peanut leaflet necrosis and chlorosis.

At Lamesa in 2009, no mid-season peanut injury was observed with any 7 DAC herbicide treatments (Table 4). In 2010, all herbicide treatments with the exception of paraquat alone at 0.14 kg/ha caused peanut injury which ranged from 5 to 14%. In 2011 at Halfway, peanut injury was greatest with the combination of flumioxazin at 0.11 kg/ha plus paraquat at 0.28 kg/ha while injury with flumioxazin alone at 0.07 kg/ha or paraquat alone at 0.14 kg/ha was 3% or less.

At Yoakum in 2009, paraquat alone at 0.28 kg/ha and herbicide combinations with the exception

Table 3. Early-season peanut injury in the Texas High Plains and south Texas as influence by flumioxazin and paraquat applied 7 days after peanut cracking.[a]

Herbicide		Lamesa		Halfway	Yoakum		
Flumioxazin	Paraquat	2009	2010	2011	2009	2010	2011
kg ai/ha		%					
0	0	0	0	0	0	0	0
0.07	0	25	23	2	63	9	17
0.11	0	35	27	8	53	10	30
0	0.14	1	0	8	25	30	18
0	0.28	0	0	12	53	65	47
0.07	0.14	33	18	10	58	33	47
0.11	0.14	40	25	15	81	43	57
0.07	0.28	27	23	12	73	55	77
0.11	0.28	38	25	13	83	67	77
LSD (0.05)		5	3	4	15	11	11

[a]Injury evaluations: Lamesa, 2009 21 days after planting (DAP); 2010, 28 DAP; Halfway, 2011 22 DAP; Yoakum 2009, 21 DAP; 2010, 20 DAP; 2011, 19 DAP.

Table 4. Mid-season peanut injury in the Texas High Plains and south Texas as influence by flumioxazin and paraquat applied 7 days after peanut cracking.[a]

Herbicide		Lamesa		Halfway	Yoakum		
Flumioxazin	Paraquat	2009	2010	2011	2009	2010	2011
kg ai/ha		%					
0	0	0	0	0	0	0	0
0.07	0	0	14	3	0	0	3
0.11	0	5	12	12	0	0	0
0	0.14	0	2	2	7	0	0
0	0.28	0	5	7	22	0	3
0.07	0.14	0	9	12	0	2	7
0.11	0.14	5	13	17	26	13	20
0.07	0.28	0	11	18	14	27	27
0.11	0.28	6	12	25	50	37	30
LSD (0.05)		NS	2	5	13	7	11

[a]Injury evaluations: Lamesa, 2009 63 days after planting (DAP); 2010, 70 DAP; Halfway, 2010 42 DAP; Yoakum 2009, 35 DAP; 2010, 78 DAP; 2011, 64 DAP.

of flumioxazin at 0.07 kg/ha plus paraquat at 0.14 kg/ha resulted in 14 to 50% injury (Table 4). In 2010, herbicide combinations, with the exception of flumioxazin at 0.07 kg/ha plus paraquat at 0.14 kg/ha resulted in injury that was greater than the untreated check. Peanut injury was greatest with combinations that included paraquat at 0.28 kg/ha. Similar trends were noted in 2011 (Table 4). In work in the southeast, Johnson *et al.* (2006) reported that flumioxazin at 0.07 kg/ha applied 8 and 10 days after planting (DAP), injured peanut up to 39% at midseason. They also reported that flumioxazin at 1.05 kg/ha applied 4 DAP or later caused up to 49% peanut injury. However, despite the injury, there was no effect of flumioxazin application timing or rate on peanut stand. The flumioxazin label states that PRE applications of this product must be made within 2 d after planting and prior to peanut emergence (Anonymous, 2009).

In other studies, herbicide systems that included paraquat have resulted in severe peanut stunting while the herbicide system which included flumioxazin plus *S*-metolachlor applied PRE followed by lactofen applied POST caused moderate peanut stunting (Grichar and Dotray 2012). Although paraquat is registered for use on peanut within 28 d after emergence, Johnson *et al.* (1993) stated that paraquat use later than 28 d after emergence is discouraged due to the potential for crop injury with less time for plant recovery. Although paraquat was applied within the safety window excessive stunting was still observed. Peanut cultivar response to paraquat was thought to be the issue; however, Wehtje *et al.* (1991) reported that foliar absorption and translocation of paraquat did not vary between peanut cultivars and they attributed yield differences to the difference in yield potential between cultivars.

Peanut yield response. Since different peanut cultivars were used in each year of the study, no attempt was made to combine yield results over years. Peanut yields were not obtained from the Yoakum location in 2009 and 2010 due to the high populations of smellmelon which prevented proper digging of plots. Weed biomass slows field-drying of peanut vines and pods and increases the likelihood of exposure to rainfall, which can increase harvesting losses (Young *et al.*, 1982; Wilcut *et al.*, 1995). The fibrous root system and vines of smellmelon is extremely difficult to separate from peanut (Wilcut *et al.*, 1994).

There was a herbicide by application timing interaction for yield; therefore those interactions are presented for each location where yield was obtained. In 2009, peanut yield increases from the untreated check (weed-free) were noted with flumioxazin alone at 0.07 kg/ha applied PRE or 0.11 kg/ha applied 7 DAC, paraquat alone at 0.14 kg/ha applied PRE, flumioxazin at 0.11 kg/ha plus prarquat 0.14 kg/ha applied PRE and 7 DAC, and flumioxazin at 0.11 kg/ha plus paraquat at 0.28 kg/ha applied PRE (Table 5). No yield reductions from the untreated check were noted with any other herbicide treatments. In 2010 at Lamesa, no differences in peanut yield were noted with any herbicide treatments whether applied PRE or 7 DAC (Table 5). However, at Halfway in 2010, paraquat alone at 0.28 kg/ha applied 7 DAC produced a lower yield than the untreated check for the 7 DAC applications. In 2011 at Yoakum, paraquat alone at 0.28 kg/ha, flumioxazin at 0.07 kg/ha plus paraquat at 0.14 or 0.28 kg/ha, or flumioxazin at 0.11 kg/ha plus paraquat at 0.28 kg/

Table 5. Peanut yield in the Texas High Plains and south Texas as influence by flumioxazin and paraquat.

Herbicide		Lamesa				Halfway		Yoakum	
		2009		2010		2011		2011	
Flumioxazin	Paraquat	PRE[a]	7DAC	PRE	7DAC	PRE	7DAC	PRE	7DAC
kg ai/ha		kg/ha							
0	0	3508	3536	6062	5981	3204	4250	2541	2815
0.07	0	4032	3850	6359	5988	3653	3587	2562	2152
0.11	0	3684	4073	6005	6010	4085	3796	3003	3161
0	0.14	4196	3774	5900	6391	3484	3132	2825	2678
0	0.28	3541	3615	5659	6295	2779	2904	2363	2048
0.07	0.14	3821	3729	5983	6053	3570	3038	2531	2005
0.11	0.14	4035	4419	5843	6029	3731	3798	2520	2152
0.07	0.28	3791	3807	6262	6039	3582	3485	2205	1502
0.11	0.28	4271	3782	6432	6222	3906	3865	2436	1786
LSD (0.05)		414		NS		1289		665	

[a]Abbreviations: PRE, preemergence; DAC, days after peanut cracking.

ha resulted in reduced yields compared with the untreated check for 7 DAC treatments (Table 5).

Early-season peanut injury (Table 3) with 7 DAC treatments did not always correspond to a reduction in peanut yield (Table 5). Only at one instance at Halfway and also at Yoakum did the severe early season injury result in any effect on peanut yield. Other studies have not reported any yield reductions with the use of paraquat (Carley *et al.*, 2009; Johnson *et al.*, 1993; Wehtje *et al.*, 1991). Previous research suggests that paraquat may affect peanut grade (especially Virginia types) by increasing the proportion of other kernels (Knauft *et al.*, 1990), which may indicate that the herbicide affected grade by delaying maturity (Carley *et al.*, 2009).

Wilcut *et al.* (2001) conducted field studies on the response of flumioxzin at 0.07 kg/ha to eight Virginai peanut cultivars and reported that flumioxain did not affect percentage grade or total yield of any cultivar. Johnson *et al.* (2006) reported under weed-free conditions flumioxazin applied within the recommended time interval (0 to 2 DAP) temporarily stunted early season growth, but peanut generally recovered by midseason with no yield reductions. They concluded if given ample time to compensate for delays in maturity, peanut yield should not be affected. Similar results were also reported by Jordan *et al.* (2009) in which they found that delaying the application of flumioxazin until peanut emergence increased injury regardless of rate but pod yield was not affected.

In conclusion, the use of flumioxazin plus paraquat applied PRE is a safe option, but the use of flumioxazin plus paraquat applied 7 DAC may result in significant peanut injury and as a consequence cause some yield reductions, most notably in the south Texas peanut growing region. Peanut injury with flumioxazin may also be enhanced by the high humidities that are common to the south Texas region. The activity of POST herbicides is usually favored under warm, humid conditions (Martinson *et al.*, 2005). In general, a high relative humidity during and after herbicide application is likely to increase herbicide penetration and absorption and increase the probability of weed mortality (Hammerton, 1967; Koukkari and Johnson, 1979; Norsworthy *et al.* 1999; Prasad *et al.*, 1967). Dew is another environmental factor that can impact the effect of herbicides on plants (Nalewaja *et al.*, 1975). Nalewaja *et al.* (1975) concluded that dew may lead to increased uptake of herbicides; however, excessive dew can lead to the herbicide being washed off, thus reducing crop injury. Times of herbicide application in the south Texas region ranged from 6:30 AM to 8:30 AM when dews typically develop while in the High Plains area, herbicides were applied from 9:30 AM until noon (data not shown). Under most conditions, little or no dew develops in this region and will surely not be present at these later times.

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