Original Research Article

Using Inpyrfluxam to Control Peanut (*Arachis hypogaea* L.) Foliar and Soil-Borne Diseases

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ABSTRACT

Aims: To determine peanut disease control and yield response to inpyrfluxam applied at various timings during the growing season.
Study design: Randomized complete block design with 4 reps.
Place and Duration of Study: Field studies were conducted from 2016 through 2020 in the south Texas peanut growing region near Yoakum(29.276^o N, 97.123^o W).
Methodology: Fungicides were applied with a CO_2-propellant sprayer. The spray boom was equipped with three D2-23 hollow-cone spray nozzles per row with the middle nozzle centered over each plant in the row and another nozzle located as such to spray on each side of the plant to provide thorough coverage with a spray volume was 187 L ha^{-1}. Some studies included a non-treated control while otherstudies included chlorothalonil only at 1.26 kg ha^{-1} as the comparison treatment. Each plot consisted of four rows spaced 97 cm apart and 7.9 m long.
Results: Inpyrfluxam applied twice in a 4 to 5 fungicide spray program in combination with chlorothalonil provided early leaf spot control as good as or better than the standards of chlorothalonil plus either azoxystrobin alone or azoxystrobin plus benzovindiflupyr applied 2 times. Control of Rhizoctonia pod rot, caused by *Rhizoctonia solani*Kuhn, with inpyrfluxam at 0.04, 0.05. 0.075, or 0.1 kg ai ha^{-1} applied 2 times during the growing season was comparable to two applications of azoxystrobin at 0.22 kg ai ha^{-1}. Control of southern blight, caused by *Sclerotiumrolfsii*Sacc., with one to two applications of inpyrfluxam at 0.05 to 1.0 kg ha^{-1} was comparable to azoxystrobin plus benzovindiflupyr. Peanut yield response was influenced by the level of soilborne and foliar disease control exhibited with each fungicide program, as those programs which provided the best control also produced the highest yield.
Conclusion: These studies show the ability of inpyrfluxam to provide control of multiple diseases found in southwest peanut production.

Keywords: Cercosporaarachidicola, early leaf spot, *Rhizoctonia solani,Sclerotiumrolfsii,*white mold, southern blight, peanut yield.

1. INTRODUCTION

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In the southwestern US peanut growing region, the control of foliar and soilborne diseases of peanut (*Arachis hypogaea* L.) requires the use of a wide range of fungicides [1-5].Two leaf spots diseases can develop in peanut including early leaf spot, caused by *Passaloraarachidicola* (previously known as *Cercosporaarachidicola* S. Hori) and late leaf spot, caused by *Nothopassalorapersonata* (previously known as *Cercosporidiumpersonatum* Berk. & M.A. Curtis). Rust, caused by *Puccinia arachidis*Speg. can also be found in all the peanut production areas of the US [6-8]. As the name implies early leaf spot is typically seenearly in the season and late leaf spot occurs later in the season. However, either disease can occur anytime during the season with characteristic dark-brown to black lesions first appearing at the bottom of the plant and progressing upward. Early leaf spot can be confirmed by spores on the upper leaf surface and late leafspot by spores on the lower leaf surface [4,6].

Despite its widespread use across the peanut belt, chlorothalonil continues to provide effective control of foliar diseases [3,7]. However, chlorothalonil has no activity against any of the soilborne diseases such as stem rot, caused by *Sclerotium rolfsii*Sacc and Rhizoctonia limb and pod rot, caused by *Rhizoctonia solani* Kuhn. [2,3,7,9-11]. For foliar disease control, depending on the fungicide program, a calendar-based spray schedule in the southeastnUS results in as many as seven applications [8,11], while in the southwestern peanut growing region, a maximum of five fungicide applications are generally made during the growing season depending on weather conditions [1,2,3,7]. In the past, chlorothalonil has been used in combination with programs utilizing azoxystrobin, pyraclostrobin, or tebuconazole to minimize the risk of fungal pathogens developing resistance [2,3,7-9,11-13].

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Southern blight (*Sclerotium rolfsii*), also known as stem rot or white mold, is a common soilborne disease found in most peanut producing regions of the southwest [2,3,7] and often is an issue due to moist conditions brought on by irrigation or rainfall [14,15]. High soil moisture promotes infection, and fungal mycelium spreads between and within plants, especially in dense stands resulting from the use of high seeding rates [16-17]. *Sclerotium rolfsii* infection is limited to basal stems, roots, pegs and pods, and coincides with beginning peg and pod formation (R2 and R3) as defined by Boote [18] when peanut branches spread rapidly across the soil surface [19].

Rhizoctoni limb and pod rot (*Rhizoctonia solani* Kuhn) can be a major factor limiting peanut production in parts of the Texas production area [1]. Because Rhizoctonia is favored by warm, wet soil conditions, producers who irrigate may find relatively high levels of this disease. Rhizoctonia pod rot also is more prevalent in fields that are not adequately rotated. Populations of this pathogen can be reduced through cultural practices and crop rotation of 3 to 5 yr [20]. Azoxystrobin, applied 2 times during the growing season, has shown excellent activity against Rhizoctonia [2,21].

Inpyrfluxam is a new fungicide for use in apples (*Malus domestica* L.), corn (*Zea mays* L.), rice (*Oryza sativa* L.), soybean (*Glycine max* L.), sugar beet (*Beta vulgaris* L.) and peanut. The inpyrfluxam active ingredient is known as Indiflin™. It is a succinate-dehydrogenase inhibitor (SDHI), in the pyrazole-4-carboxamide group, and has a mode of action inhibiting energy production process which in turn hinders fungal growth [22,23]. This mode of action is different from the QoI inhibitors (strobilurins) which act to inhibit the respiratory chain at the complex III (coenzyme Q: cytochrome c-oxidoreductase) [24]. It is in the Group 7 class of fungicides as classified by the Fungicide Resistance Action Committee (FRAC) [25].

The objectives of this study was to determine the effectiveness of inpyrfluxam for control of peanut foliar and soilborne diseases and subsequent yield response in the south Texas peanut growing regions. Of particular interest were comparisons of inpyrfluxam with either azoxystrobin alone or azoxystrobin plus benzovindiflupyr with chlorothalonil for foliar, southern blight, or Rhizoctonia limb and pod rot disease control.

2. MATERIAL AND METHODS

2.1. Field studies. These studies were conducted at the Texas A&M AgriLife Research Site near Yoakum (29.276^o N, 97.123^o W) in south-central Texas to determine peanut disease control and yield response to applications of inpyrfluxam applied at various application timings during the growing season. These studies were in the same general area within a field but were moved each year to different locations within the field. Soil type was a Tremona loamy fine sand (thermic Aquic arenicPaleustalfs) with less than 1% organic matter and pH 7.1 to 7.4. Other details of the study including peanut variety, planting and harvest date, sprayer type, and spray volume are presented in Table 1.

Table 1. Variables with each study at Yoakum, TX.

Year	Study type	Variety	Planting date	Harvest date
2016	Rhizoctonia	Webb	21 June	30 Nov
	Southern blight	Webb	21 June	29 Nov
2017	Rhizoctonia	Georgia 09B	14 June	20 Nov
	Southern blight	Georgia 09B	14 June	20 Nov
2018	Rhizoctonia	Georgia M-13	26 June	18 Dec
	Southern blight	Georgia M-13	26 June	18 Dec
2019	Rhizoctonia	Georgia 09B	26 June	4 Dec
	Southern blight	Georgia 09B	26 June	4 Dec
2020	Rhizoctonia	Georgia 09B	1 July	8 Dec
	Southern blight	Georgia 09B	1 July	8 Dec

2.2 Fungicide application and plot design. In all studies fungicides were applied with a CO_2-propellant sprayer. The spray boom was equipped with three D2-23 hollow-cone spray nozzles per row with the middle nozzle centered over each plant in the row and another nozzle located as such to spray on each side of the plant in a row to provide thorough coverage. Spray volume was 187 L ha^{-1} and the experimental design was a randomized complete block with four replications. Some studies included a non-treated control while others included chlorothalonil only at 1.26 kg ha^{-1} as the comparison treatment. Each plot consisted of four rows spaced 97 cm apart and 7.9 m long. Only the middle 2 rows of each plot were sprayed with fungicide and one row on each side served as a buffer to prevent drift from affecting adjacent plots.

2.3 Visual evaluations. The trial locations had a history of early leafspot, Rhizoctonia limb and pod rot, and southern blight disease pressure due to being in continuous peanut production for over 40 yrs and in all instances relied on natural inoculum for infection. Peanut phytotoxicity ratings were taken 7 to 14 d after treatment at all locations. Peanut injury, if present, was visually estimated on a scale of 0 to 100 (0 indicating no leaf chlorosis or necrosis and 100 indicating complete peanut kill), relative to the non-treated control or chlorothalonil treatments. Severity of leaf spot was rated in the center two rows of each plot using the Florida leaf spot 1-10 index where 1 = no leaf spot and 0% defoliation; 2 = very few lesions and none on the upper canopy with 0% defoliation; 3 = few lesions and very few on the upper canopy with 0% defoliation; 4 = some lesions with more on upper canopy and 5%

defoliation; 5 = lesions noticeable even on upper canopy and 20% defoliation; 6 = lesions numerous and very evident on upper canopy with 50% defoliation; 7 = lesions numerous on upper canopy with 75% defoliation; 8 = upper canopy covered with lesions with 90% defoliation; 9 = very few leaves remaining and those covered with lesions, some plants completely defoliated; and 10 = plants completely defoliated or dead [6,11,26]. The leaf spot rating was taken several days prior to peanut digging.

Plants were dug based on pod maturity [27] and incidence of loci of Rhizoctonia pod rot or southern blight was determined immediately after peanut plants were inverted. Disease incidence was assessed by counting 31 cm or less of segment of the row with symptomatic plants infected with *Rhizoctonia solani* or *S. rolfsii*[28] and is expressed as percent infection.

2.4 Plot maintenance and peanut digging. All test areas were maintained weed-free with preemergence and postemergence herbicides commonly used to control weeds in peanut. Sprinkler irrigation was applied on a 1- to 2-wk schedule throughout the growing season as needed. Peanut yields were obtained after digging each plot separately, air-drying in the field for 4 to 7 d, and harvesting pods from each plot with a combine. Weights were recorded after drying to 10% moisture and cleaning to remove soil and plant debris.

2.5 Data analysis. Data were subjected to ANOVA and analyzed using SAS PROC MIXED with locations and years designated as random effects in the model [29]. Treatment means were separated using Fisher's Protected LSD at $P \leq 0.05$. Since fungicide treatments and application timings varied for years, trials were evaluated separately and no attempted was made to consolidate data over years.

3. RESULTS AND DISCUSSION

No peanut phytotoxicity was noted with any inpyrfluxam treatment (data not shown). In all studies chlorothalonil at 1.26 kg ai ha^{-1} was included with each fungicide spray program. Chlorothalonil is the foundation of peanut leaf spot control programs because it is the only fungicide proven to have multiple modes of action to the reduce the risk of developing leaf spot resistance [30]. Alternating or tank mixing chlorothalonil with other fungicides can delay development of resistance towards these alternative fungicides. Chlorothalonil in the last scheduled spray can also help prevent resistant leaf spot strains from overwintering and causing infection in the following year [30].

These studies were divided into the Rhizoctonia study and the southern blight study based on the soil-borne diseases present in each area. Accordingly, information on the effectiveness of inpyrfluxam against each of these diseases could be obtained in addition to information on the control of foliar diseases which was common to both areas.

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3.1 Rhizoctonia study.

3.1.1 Soil-borne disease incidence. In 2016 the untreated check and inpyrfluxam at 0.025 kg ai ha^{-1} resulted in the highest disease incidence while inpyrfluxam at 0.05 or 0.075 kg ai ha^{-1} resulted in disease incidence that was comparable to azoxystrobin at 0.22 kg ai ha^{-1} (Table 2). In 2017, under greater disease pressure, inpyrfluxam at 0.05 kg ha^{-1} resulted in disease incidence comparable with azoxystrobin and 49% less than chlorothalonil alone (Table 3). In 2018, azoxystrobin reduced *Rhizoctonia* disease incidence by 73% from chlorothalonil alone and inpyrfluxam reduced disease incidence 52% (Table 4) while in 2019 inpyrfluxam at 0.05 kg ha^{-1} reduced disease incidence 85% compared with azoxystrobin which reduced incidence 63% from chlorothalonil alone (Table 5). In 2020, under low disease pressure, inpyrfluxam at 0.05 kg ha^{-1} reduced disease incidence from the untreated check 49% and inpyrfluxam at 0.1 kg ai ha^{-1} reduced incidence 71% while the combination of azoxystrobin at 0.06 kg ai ha^{-1} + benzovindiflupyr at 0.15 kg ai ha^{-1} reduced disease incidence 75% (Table 6). While chlorothalonil has no activity against either *Rhizoctonia* or *S. rolfsii*[2,9,10,11,31], azoxystrobin does have activity against both *R. solani* and *Pythium* spp. [2,32].

3.1.2 Early leaf spot incidence. Earlyleaf spot was only evaluated in the Rhizoctonia

Table 2. Foliar and soil-borne disease control in peanut with inpyrfluxam in 2016.

Fungicide	Rate Kg ai ha^{-1}	Appl time[a]	Rhizoctonia study Infection	Rhizoctonia study Yield	Southern blight study Early leafspot[b]	Southern blight study Infection	Southern blight study Yield
			%	Kg ha^{-1}		%	Kg ha^{-1}
Untreated	-	-	10.0	2576	7.4	28.0	1564
Chlorothalonil	1.26	AC					
Azoxystrobin	0.22	BD	4.0	3833	-	-	-
Chlorothalonil	1.26	AC					
Inpyrifluxam	0.025	BD	11.5	2932	-	-	-
Chlorothalonil	1.26	AC					
Inpyrfluxam	0.05	BD	3.0	3399	-	-	-
Chlorothalonil	1.26	AC					
Inpyrfluxam	0.075	BD	4.5	4150	-	-	-
Chlorothalonil	1.26	A-E					
Flutolanil	1.06	A-D	-	-	2.5	6.0	4096
Chlorothalonil	1.26	A-E					
Flutolanil +	1.06 +	A-D					
Inpyrfluxam	0.044		-	-	3.3	2.0	4281
LSD (0.05)			3.9	1044	0.5	6.0	648

[a] Application timing for the Rhizoctonia study: A, 63 days after planting (DAP); B, 83 DAP; C, 94 DAP; D, 118 DAP. For the early leafspot and southern blight study: A, 60 DAP; B, 79 DAP; C, 96 DAP; D, 113 DAP; E, 130 DAP.

[b] Leaf spot assessed using the Florida leaf spot index where 1 = no leaf spot and 0% defoliation; 2 = very few lesions and none on the upper canopy with 0% defoliation; 3 = few lesions and very few on the upper canopy with 0% defoliation; 4 = some lesions with more on upper canopy and 5% defoliation; 5 = lesions noticeable even on upper canopy and 20% defoliation; 6 = lesions numerous and very evident on upper canopy with 50% defoliation; 7 = lesions numerous on upper canopy with 75% defoliation; 8 = upper canopy covered with lesions with 90% defoliation; 9 = very few leaves remaining and those covered with lesions, some plants completely defoliated; and 10 = plants completely defoliated or dead.

studies in 2019 and 2020 (Tables 5-6). In 2019, there were no differences in leaf spot development between inpyrfluxam at 0.05 and chlorothalonil or azoxystrobin (Table 5). In2020, again no differences were noted between the chlorothalonil only and azoxystrobin plus

bensovinviflupyr or inpyrfluxam at 0.05 or 0.1 kg ha^{-1} treatments; however, all fungicide treatments had less early leaf spot than the untreated check (Table 6). Since chlorothalonil is a protectant fungicide with no curative properties and has no activity against soilborne diseases, it is most effective when applied prior to infection [13] and good coverage of the foliage is essential for effective control of leaf spot [33]. It can also be applied in alternating applications, alternating blocks of applications, or in application regime mixtures with other fungicides to prevent late-season or secondary infections, and to reduce the risk of developing resistance in *P. arachidicola* or *N. personata* populations to systemic fungicides [34,35].

3.1.3 Peanut yield. In 2016, inpyrfluxam at 0.075 kg ha^{-1} produced the highest yield while the untreated check produced the lowest yield (Table 2). Azoxystrobin and inpyrfluxam at

Table 3. Soil-borne disease control in peanut with inpyrfluxam in 2017.

Fungicide	Rate Kg ai ha^{-1}	Appl time[a]	Rhizoctonia study		Southern blight study	
			Infection	Yield	Infection	Yield
			%	Kg ha^{-1}	%	Kg ha^{-1}
Chlorothalonil	1.26	A-D	20.5	2438	26.0	2592
Chlorothalonil	1.26	A-D				
Azoxystrobin	0.22	BC	8.5	2658	-	-
Chlorothalonil	1.26	A-D				
Prothioconazole	0.07	BC				
+ Tebuconazole	+ 0.15		-	-	12.0	2371
Chlorothalonil	1.26	A-D				
Inpyrfluxam	0.05	BC	10.5	2514	6.5	2500
Chlorothalonil	1.26	A-D				
Inpyrfluxam	0.075	B	-	-	15.6	2553
LSD (0.05)			9.4	NS	7.1	NS

[a] Application timing for the Rhizoctonia study: A, 57 days after planting (DAP); B, 78 DAP; C, 97 DAP; D, 116 DAP. For the southern blight study: A, 61 DAP; B, 78 DAP; C, 96 DAP; D, 116 DAP.

0.075 kg ha^{-1} increased peanut yield over the untreated check 48 and 61% respectively. As inpyrfluxam rate increased peanut yield increased numerically. In 2017, 2018, or 2019 there

Table 4. Soil-borne disease control in peanut with inpyrfluxam in 2018.

Fungicide	Rate Kg ai ha^{-1}	Appl time[a]	Rhizoctonia study		Southern blight study	
			Infection	Yield	Infection	Yield
			%	Kg ha^{-1}	%	Kg ha^{-1}
Chlorothalonil	1.26	A-D	14.7	2339	10.4	2382
Chlorothalonil	1.26	A-D				
Azoxystrobin	0.22	BC	3.9	2317	-	-
Chlorothalonil	1.26	A-D				
Azoxystrobin +	0.06 +					
benzovindiflupyr	0.15	B	-	-	3.0	2188
Chlorothalonil	1.26	A-D				
Inpyrfluxam	0.05	BC	7.1	2493	3.0	1981
Chlorothalonil	1.26	A-D				
Inpyrfluxam	0.075	B	-	-	3.7	2392
Chlorothalonil	1.26	A-D				
Inpyrfluxam	0.1	B	-	-	3.0	2189
LSD (0.05)			5.4	NS	1.7	373

[a] Application timing for both studies: A, 59 days after planting (DAP); B, 70 DAP; C, 91 DAP; D, 110 DAP.

was not a yield difference between chlorothalonil and any other fungicide treatments (Table 3-5). In 2020, azoxystrobin plus benzovindiflupyr and all inpyrfluxam treatments increased yield over the untreated check and chlorothalonil alone treatments (Table 6).

3.2 Southern blight study

3.2.1 Southern blight disease incidence. In 2016 disease incidence was high with theinfection rate for the untreated check at 28% while chlorothalonil plus either flutolamil alone or flutolanil plus inpyrfluxamresulted in 6 and 2% infection, respectively (Table 2).

Table 5. Foliar and soil-borne disease control in peanut with inpyrfluxam in 2019.

Fungicide	Rate Kg ai ha^{-1}	Appl time[a]	Rhizoctonia study: Early leafspot[b]	Rhizoctonia study: Infection	Rhizoctonia study: Yield	Southern blight study: Early leafspot	Southern blight study: Infection	Southern blight study: Yield
				%	Kg ha^{-1}		%	Kg ha^{-1}
Chlorothalonil	1.26	A-E	2.9	11.3	4002	2.7	12.1	3721
Chlorothalonil	1.26	A-E						
Azoxystrobin	0.22	BD	2.6	4.2	4285	-	-	-
Chlorothalonil	1.26	A,C,E						
Azoxystrobin	0.06 +							
+benzovindiflup yr	0.15	BD	-	-	-	4.0	5.8	3805
Chlorothalonil	1.26	A-E						
Inpyrfluxam	0.05	BD	2.7	1.7	4328	2.2	3.3	4113
Chlorothalonil	1.26	A-D						
Inpyrfluxam	0.1	B	-	-	-	2.5	2.9	4172
LSD (0.05)			0.7	3.5	NS	0.9	5.0	449

[a]Application timing for the Rhizoctonia study: A, 48 days after planting (DAP); B, 62 DAP; C, 82 DAP; D, 96 DAP; E, 122 DAP. For the early leafspot and southern blight study: A, 48 DAP; B, 68 DAP; C, 83 DAP; D, 101 DAP; E, 130 DAP.

[b] Leaf spot assessed using the Florida leaf spot index where 1 = no leaf spot and 0% defoliation; 2 = very few lesions and none on the upper canopy with 0% defoliation; 3 = few lesions and very few on the upper canopy with 0% defoliation; 4 = some lesions with more on upper canopy and 5% defoliation; 5 = lesions noticeable even on upper canopy and 20% defoliation; 6 = lesions numerous and very evident on upper canopy with 50% defoliation; 7 = lesions numerous on upper canopy with 75% defoliation; 8 = upper canopy covered with lesions with 90% defoliation; 9 = very few leaves remaining and those covered with lesions, some plants completely defoliated; and 10 = plants completely defoliated or dead.

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In 2017 disease incidenceagain was high with the chlorothalonil only treatment having an infection rate of 26% while prothioconazole + tebuconazole resulted in a 12% infection rate

(Table 3). Inpyrfluxam at 0.05 and 0.075 kg ha^{-1} resulted in an infection rate of 6.5 and 15.6%, respectively. In 2018,under lower disease incidence, the chlorothalonil only treatment showed an infection rate of only 10.4% while all fungicide treatments reduced disease incidence to no greater than 3.7% (Table 4). In 2019, again under light pressure, the chlorothalonil only treatment showed a disease incidence of 12.1%, while azoxystrobin plus benzovindiflupyr showed a disease incidence of 5.8%and both rates of inpyrfluxam resulted in < 3.3% disease incidence (Table 5). In 2020, the chlorothalonil only treatment had a disease incidence of 11.7% while the azoxystrobin plus benzovindiflupyr treatment resulted in a 3.1% disease incidence (Table 6). As inpyrfluxam rate increased disease incidence decreased from 5.9% to 2.4%.

<u>3.2.2 Early leaf spot incidence</u>. Early leaf spot was evaluated in the southern blight test in 2016, 2019, and 2020. In 2016, under heavy disease pressure, chlorothalonil plus either flutolanil or flutolanil plus inpyrfluxam reduced early leaf spot 56 to 67% when compared with the untreated check (Table 2). In 2019, azoxystrobin plus benzovindiflupyr resulted in a Florida leaf spot rating scale of 4.0 while chlorothalonil alone or chlorothalonil plus inpyrfluxam at 0.05 or 1.0 kg ha^{-1} resulted in rating of ≤2.7 (Table 5). In 2020, inpyrfluxam at 0.075 kg ha^{-1} showed a higher leaf spot rating than chlorothalonil alone; however, there were no differences in foliar disease development between azoxystrobin plus benzovindiflupyr and any inpyrfluxam treatments (Table 6).

In a previous study, Grichar et al. reported that azoxystrobin plus benzovindiflupyr provided early leaf spot control comparable to prothioconazole plus tebuconazole and other fungicide programs [7]. Strobilurins such as azoxystrobin move across the leaf surface and into the waxy cuticle of the leaf (locally systemic) and may even move into the cuticle on the underside of the leaf (translaminar activity) [36]. Some azoxystrobin may also move into the xylem and be transported upwards [37]; however, little of the fungicide moves down to the roots [38,39].

<u>3.2.3 Peanut yield.</u> In 2016 chlorothalonil plus either flutolanil or flutolanil plus inpyrfluxam increased yield over the untreated check by 160% (Table 2). In 2017 there were no yield differences between chlorothlonil alone and any other fungicide treatments (Table 3). In 2018, chlorothalonil alone or in combination with inpyrfluxam at 0.075 kg ha^{-1} resulted in

Table 6. Foliar and soil-borne disease control in peanut with inpyrfluxam in 2020.

			Rhizoctonia study			Southern blight study		
Fungicides	Rate Kg ai ha^{-1}	Appl time[b]	Early leafspot[c]	Infection	Yield	Early leafspot	Infection	Yield
				%	Kg ha^{-1}		%	Kg ha^{-1}
Untreated	-	-	6.9	7.9	2066	-	-	-
Chlorothalonil	1.26	A-E	3.5	3.5	2370	1.9	11.7	1893
Chlorothalonil	1.26	A,C,E						
Azoxystrobin + benzovindiflupyr[a,b]	0.06 + 0.15	B,D	3.0	2.0	3010	2.1	3.1	2472
Chlorothalonil	1.26	A,C,E						
Inpyrfluxam	0.05	B,D	3.2	4.0	2895	2.6	5.9	2634
Chlorothalonil	1.26	A,C,E						
Inpyrfluxam	0.075	B,D	-	-	-	2.9	5.1	2552
Chlorothalonil	1.26	A,C,E						
Inpyrfluxam	0.1	B,D	2.8	2.3	2910	2.5	2.4	2696
LSD (0.05)			2.1	2.9	460	1.0	2.9	444

[a] Azoxystrobin + benzovindiflupyr rate for the Rhizoctonia study was 0.05 + 0.12 kg ha^{-1}.
[b] Application timing for the Rhizoctonia study: A, 49 days after planting (DAP); B, 66 DAP; C, 82 DAP; D, 101 DAP; E, 118 DAP. For the early leafspot and southern blight study: A, 48 DAP; B, 67 DAP; C, 82 DAP; D, 102 DAP; E, 118 DAP.
[c] Leaf spot assessed using the Florida leaf spot index where 1 = no leaf spot and 0% defoliation; 2 = very few lesions and none on the upper canopy with 0% defoliation; 3 = few lesions and very few on the upper canopy with 0% defoliation; 4 = some lesions with more on upper canopy and 5% defoliation; 5 = lesions noticeable even on upper canopy and 20% defoliation; 6 = lesions numerous and very evident on upper canopy with 50% defoliation; 7 = lesions numerous on upper canopy with 75% defoliation; 8 = upper canopy covered with lesions with 90% defoliation; 9 = very few leaves remaining and those covered with lesions, some plants completely defoliated; and 10 = plants completely defoliated or dead.

greater yields than chlorothalonil plus inpyrfluxam at 0.05 kg ha^{-1}. Azoxystrobin plus benzovindiflupyr was intermediate in yield (Table 4). In 2019 chlorothalonil plus inpyrfluxam at 0.1 kg ha^{-1} resulted in a greater yield than chlorothalonil alone (Table 5) while in 2020 azoxystrobin plus benzovindiflupyr and all inpyrfluxam treatments resulted in a greater yield than chlorothalonil alone (Table 6).

4.0 CONCLUSION

Peanutgrown in the southwest US are susceptible to numerous foliar and soilborne diseases, thus fungicides are intensely used in these areas. Several fungicides are registered for use in peanut; however, spray programs comprised of multiple modes of action are recommended based on target diseases for resistance disease management. In addition, sequential applications are required to provide season-long control. Woodward *et al*. [4] reported that chlorothalonil should be included with tebuconazole for management of leaf spot where resistance has developed. Also, Brenneman and Culbreath [12]stated that resistant management recommendations include the use of a non-sterol demethylation inhibiting (DMI) fungicide prior to and after applications of a DMI fungicide such as tebuconazole.

Information regarding the performance of inpyrfluxam in a peanut fungicide program for disease control in the southwestern US has been lacking. These results provide a basis of comparison of inpyrfluxam in various fungicide programs to other fungicides commonly used in the region. Inpyrfluxam represents a new broad-spectrum fungicide that producers can use in developing management strategies for various diseases. These studies confirm that inpyrfluxam is highly effective against Rhizoctonia pod and limb rot and southern blight but must be partnered with other fungicides for effective leaf spot control. Inpyrfluxam can also be an important tool for fungicide resistance management.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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