EVALUATION TRIALS ON USING PYROXASULFONE IN WHEAT

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INTRODUCTION

There is increasing interest to develop pyroxasulfone as a herbicide for use in wheat. It is similar in chemistry to flufenacet which is one of the ingredients included in Axiom. Pyroxasulfone has been evaluated in other crops under the experimental code KIH-485.

One of the benefits of using pyroxasulfone in wheat is that it is one of the few herbicide options that offer soil-residual control of small seeded annual grasses and broadleaf weeds. It also provides an alternative mode as opposed to ALS and ACCase inhibitors that are commonly used in wheat. Pyroxasulfone limits shoot growth by inhibiting long chain fatty acid enzymes. Based on current information, herbicides with this mode of action are at low risk of developing herbicide-resistant weeds.

The four formulations of pyroxasulfone that were evaluated at UKREC are listed in *Table* 1.

TABLE 1. **PYROXASULFONE FORMULATIONS EVALUATED (UKREC 2011-2012)**

PRODUCT	ACTIVE INGREDIENT	COMPANY
Anthem	pyroxasulfone + fluthiacet (CADET)	FMC
F9312-2	pyroxasulfone + carfentrazone (AIM)	FMC
Fierce	pyroxasulfone + flumioxazin (VALOR)	Valent
Zidua	pyroxasulfone	BASF

Five trials involving pyroxasulfone were conducted at UKREC this past season. Most of the data for these trials are presented in Tables 2 – 6. The following are highlights of the results for these studies:

ITALIAN RYEGRASS CONTROL USING PYROXASULFONE PRODUCTS (*ZIDUA FIERCE, & ANTHEM*) PREEMERGENCE AND AXIAL XL POSTEMERGENCE (*Table 2*).

•Preemergence control of ryegrass at eight weeks (approximately mid December) after application of Zidua, Fierce, and Anthem was 94, 95, and 91%, respectively. However, by the end of the season ryegrass control with Zidua, Fierce, and Anthem was 73, 83, and 73%, respectively.

•There were a significant number of ryegrass seedheads at the end of the season for the pyroxasulfone herbicides and ranged from a low of 19.3 heads/ft^2 for Zidua to a high of 32.6 heads/ft^2 for Anthem.

•Axial XL provided 99-100% ryegrass control regardless whether it was applied alone on the fall or spring or applied as a sequential treatment following Zidua, Fierce, or Anthem.

•The better ryegrass control achieved with Fierce allowed for greater wheat yield compared with Zidua and Anthem. Fierce applied alone out yielded Anthem and Zidua by 15.8 and 23.3 bu/A, respectively.

•The use of a sequential program of pyroxasulfone followed in the spring with Axial XL, provided better wheat yield compared with Zidua, Fierce, or Anthem, alone. There was a similar trend where the sequential program provided better wheat yield over that achieved with the spring treatment of Axial XL alone, however, the differences were not always statistically significant.

STRATEGIES FOR MANAGING ITALIAN RYEGRASS USING ZIDUA ALONE OR IN COMBINATION WITH SHARPEN (*Table 3*).

•Ryegrass control at 2 weeks after application was equal for Zidua at 1, 1.5 and 3 oz/A. However, by eight weeks after application, ryegrass control declined for Zidua at the 1 and 1.5 oz/A rates. Ryegrass control at the end of the season for Zidua at 1, 1.5, and 3 oz/A was 58, 68, and 83%, respectively.

•The number of ryegrass seedheads at the end of the season for Zidua at 3 oz/A was 15/ft^2 compared with 56 and 59 heads/ft^2 for Zidua at 1 and 1.5 oz/A.

•The use of Sharpen as a tankmix partner with Zidua at 1.5 oz/A allowed for 91% ryegrass control at 8 WAT, which was 11% greater than Zidua alone. However, by maturity, ryegrass control declined to 70%.

•Axial XL applied in the fall provided superior control of ryegrass compared with Zidua at 1, or 1.5 oz/A alone or in combination with Sharpen.

•Wheat yield with Zidua at 1 or 1.5 oz/A was significantly less compared with the yield of Zidua at 3 oz/A or Axial XL.

•Although the 3 oz/A rate of Zidua still had some ryegrass at the end of the season, its yield was statistically equal to Axial XL.

ITALIAN RYEGRASS CONTROL USING ANTHEM, F9312-2, FINESSE, ZIDUA, AND POWERFLEX (*Table 4*).

• Ryegrass control 14 Days After Treatment (DAT) with F9312-2 at 3.7, 5.57, 7.4, and 14.8 oz/A was 83, 90, 92, and 99%, respectively. F9312-2 generally maintained these levels of control through 60 DAT (December 14th). However, control declined slightly by maturity.

• Anthem at 4.9 oz/A provided 90% ryegrass control at 60 DAT when applied at preemergence compared with 83% control when applied early postemergence approximately 2 weeks later when ryegrass was 2" tall with 1 leaf. Control with Anthem at maturity was approximately 80% for both the preemergence and early postemergence treatments.

•Preemergence ryegrass control at 60 DAT with Anthem, Zidua, and Finesse was 90, 83, and 78%, respectively. The level of control at maturity with these three herbicides ranged from 70 to 80%.

•The only preemergence treatment where wheat yield exceeded 100 bu/A occurred with F9312-2 at 14.8 oz/A. Wheat yield also exceeded 100 bu/A where PowerFlex was applied alone or sequentially or in conjunction with Anthem or F9312-2.

•Although wheat injury ratings are not reported in Table 4, there were some interesting trends. F9312-2 at the low rate of 3.7 oz/A did not injure wheat; yet, there was some injury with the other rates, and persisted through 159 DAT for the high rate of 14.8 oz/A. Some wheat injury occurred with Anthem applied preemergence, but did not occur when it was applied early postemergence when wheat had 1 to 2 leaves.

RESPONSE OF EMERGING ITALIAN RYEGRASS TO EARLY POST APPLICATIONS OF SOIL-RESIDUAL HERBICIDES (*Table 5*).

• The initial control at 2 Weeks After Treatment (WAT) was greatest with Fierce at 90% followed by Valor at 50%. Ryegrass control steadily increased for most treatments through 8 WAT indicating plant mortality had taken place during this period. By 17 WAT (April 6) ryegrass control was 0% for Valor compared with 77 to 87% control with the other herbicide treatments.

•Fierce (i.e. combination of pyroxasulfone and flumioxazin) tended to provide better ryegrass control than either of the components (i.e. Zidua & Valor) applied separately.

•Under these unique circumstances it appeared that pyroxasulfone treatments in conventional tilled soil may have aided in the control of emerging annual ryegrass in the 1-leaf stage at

an average height of 1.75". The cool temperatures in early December may have contributed stress to young tender seedlings in addition to the stress from herbicide treatments. It is not clear this type of response to pyroxasulfone herbicide product will be consistent under normal environmental conditions.

IMPACT OF EARLY POSTENERGENCE HERBICIDES ON HENBIT CONTROL AND WHEAT INJURY (*Table 6*).

•Control of emerged henbit ranged from 93 to 100% at 117 days after application of Valor and Fierce. Early postemergence applications of Anthem and Zidua were not as effective in controlling emerging henbit compared to products that contained flumioxazin (Valor & Fierce). Results of previous research indicate pyroxasulfone is capable of managing henbit when applied prior to weed emergence.

•All treatments caused injury in the form of stunting and/or slight chlorosis. Including nonionic surfactant and ammonium sulfate as additives increased injury for Anthem at 4.9 oz/A and Valor at 2 oz/A, but was relatively safe with Zidua.

•Injury with Fierce was greater with the 6 oz/A rate compared with the 3 oz/A rate.

•There was a slight trend in lower wheat yield where crop injury was observed through 117 days after treatment; yet, these differences were not statistically significant.

TABLE 2. **ITALIAN RYEGRASS CONTROL USING PYROXASULFONE PRODUCTS (*ZIDUA, FIERCE, AND ANTHEM*) PREEMERGENCE AND AXIAL XL POSTEMERGENCE (UKREC 2011-2012)**

HERBICIDE	TIMING	RYEGRASS					WHEAT Yield (Bu/A) (6/6/12)
		---------- % CONTROL ----------				(Heads/Ft^2)	
		2 WAT	4 WAT	8 WAT	MATURITY (5-24-2012)	(5-22-12)	
Zidua (1.5 oz/A)	Pre	98	91	94	73	19.3	68
Zidua (1 oz) Axial XL (16.4 oz/A)	Pre Spr Post	92	99	99	99	0.8	99.9
Fierce (3 oz/A)	Pre	89	95	95	83	19.4	91.3
Fierce (3 oz/A) Axial XL (16.4 oz/A)	Pre Spr Post	99	100	99	99	0.3	107.6
Anthem 4.9 oz/A	Pre	90	88	91	73	32.6	75.5
Anthem 4.9 oz/A)+ Axial XL (16.4 oz/A)	Pre Spr Post	98	100	100	100	0.5	103.8
Axial XL (16.4 oz/A)	Fall Post	0	100	97	99	1.4	100.4
Axial XL (16.4 oz/A)	Spr Post	80	93	97	99	2.8	90.4
Non-treated Check		0	0	0	0	62.3	29.8
	LSD $_{(0.05)}$	4	5	3	7		13.5

[1] Anthem: (pyroxasulfone + fluthiacet [Cadet])
Fierce: (pyroxasulfone + flumioxazin [Valor])
Zidua: (pyroxasulfone)
Axial XL: (pinoxaden)

- Axial treatments applied in 10 GPA volume. All other treatments applied in 20 GPA volume.
- Applied Gramoxone at 3 pt/A burndown and overseeded ryegrass 10-13-11.
- Planted Pioneer 25 R32 at 37 viable seed/ft^2 10-14-2011
- Pre: 10-15-11 (First significant rainfall event occurred at 4 days after Pre treatment)
- Fall Post 11-17-11 (Wheat 4" tall & 3 leaf and Ryegrass 2.5" 1 tiller)
- Spr Post 03-01-12 (Wheat 4 ½ " tall 3 tiller and Ryegrass 4" tall and 5 tillers)
- Ryegrass control ratings made at 2, 4, and 8 Weeks After Last Treatment (WAT) and late season 5-24-12.

TABLE 3. **STRATEGIES FOR MANAGING ITALIAN RYEGRASS USING ZIDUA ALONE OR IN COMBINATION WITH SHARPEN (UKREC 2011-2012)**

HERBICIDE [1]	TIMING	RYEGRASS					WHEAT
		---------- % CONTROL ----------				(Heads/Ft^2)	(Yield Bu/A)
		2 WAT	4 WAT	8 WAT	MATURITY (5-24-2012)	(5-22-12)	(6/6/12)
Non-treated Check		0	0	0	0	68	27.9
Zidua (1. oz/A)	Pre	89	80	75	58	56	53.7
Zidua (1.5 oz/A)	Pre	90	90	85	68	59	65.5
Zidua (3 oz/A)	Pre	90	91	91	83	15	96
Zidua (1 oz/A)+ Sharpen (1.5 oz/A) + MSO (1 pt/A)	Pre	88	84	86	65	50	63.8
Zidua (1.5 oz/A)+ Sharpen (1.5 oz/A) + MSO (1 pt/A)	Pre	94	94	91	70	43	68.7
Axial XL (16.4oz/A)	Post	-	-	-	99	1	99.6
	LSD $_{0.05)}$	6	4	7	6	16	13.5

[1] Zidua: (pyroxasulfone)
Sharpen: (saflufenacil)
Axial XL (pinoxaden)

- Axial treatments applied in 10 GPA volume. All other treatments applied in 20 GPA volume.
- Applied Gramoxone at 3 pt/A burndown and overseeded ryegrass 10-13-2011.
- Planted Pioneer 25 R32 at 37 viable seed/ft^2. 10-14-2011
- Pre: 10-15-11 (First significant rainfall event occurred at 4 days after Pre treatment).
- Post: 11-23-11 (Wheat 2 tiller & Ryegrass 3 leaf to 3 tiller (average 2 tiller).
- Ryegrass control ratings made at 2, 4, and 8 Weeks After Last Treatment and late season on 5-24-12.

TABLE 4. **ITALIAN RYEGRASS CONTROL USING ANTHEM, F9312-2, FINESSE, ZIDUA, and POWERFLEX. (UKREC 2011-2012)**

HERBICIDE [1]	TIMING	RYEGRASS					WHEAT
		---------- (%) CONTROL ----------				(Heads/Ft^2)	Yield (Bu/A)
		14 DAT	30 DAT	60 DAT	MATURITY 5-24-2012	(5-22-12)	(6/6/12)
F9312-2 (3.7 oz/A)	Pre	83	78	78	60	40.5	69
F9312-2 (5.57 oz/A)	Pre	90	88	90	80	33.8	89.4
F9312-2 (7.4 oz/A)	Pre	92	93	93	88	19.9	89.7
F9312-2(14.8 oz/A)	Pre	99	98	99	91	6.8	102.7
Anthem (4.9 oz/A)	Pre	94	91	90	80	24.9	85.2
Finesse (0.4 oz/A)	Pre	85	80	78	73	36.4	77
Zidua (1.5 oz/A	Pre	88	89	83	70	33.9	80.8
F9312-2 (5.57 oz/A) PowerFlex (3.5 oz/A) NIS + AMS	Pre EP EP	88	90	99	91	4.3	117.1
Anthem (4.9 oz/A) NIS + AMS	EP EP	---	60	83	81	22	86.4
Anthem (4.9 oz/A PowerFlex (3.5 oz/A) NIS + AMS	EP EP EP	---	70	99	91	3.8	112
PowerFlex (3.5 oz/A) NIS + AMS	EP EP	---	70	99	95	9.3	108.5
Anthem (4.9 oz/A) Anthem (4.9 oz/A) PowerFlex (3.5 oz/A) NIS + AMS	Pre SPR SPR SPR	88	88	90	99	0	111.2
Non-Treated Check		0	0	0	0	63.6	27.9
	$LSD_{(0.05)}$	7	4	4	22	16.5	12.1

[1] Anthem: experimental code F9310-6 (pyroxasulfone + fluthiacet [Cadet])
F9312-2: (pyroxasulfone + carfentrazone [Aim])
Finesse: (chlorsulfuron [Glean] + metsulfuron [Ally])
PowerFlex: (pyroxsulam)
Zidua: experimental code F6180 or KIH-485 (pyroxasulfone).

- Applied Gramoxone at 3 pt/A burndown and overseeded ryegrass 10-13-11.
- Planted Pioneer 25 R32 at 37 viable seed/ft^2. 10-14-2011
- Pre: 10-15-11 (First significant rainfall event occurred at 4 days after Pre treatment).
- Early Postemergence: 11-01-11 (Wheat 1-2 leaves & 3" tall. Ryegrass 1 leaf approximately 2" tall).
- Spring Post: 03-01-12 (Wheat 3 tillers & 4.5" tall. Ryegrass 5 tillers and 4" tall.
- Ryegrass ratings made at 2, 4, and 8 Weeks After Last Treatment & late season on 5-24-12.

TABLE 5. **RESPONSE OF EMERGING ITALIAN RYEGRASS TO EARLY POST APPLICATIONS OF SOIL- RESIDUAL HERBICIDES. (UKREC 2011-2012)**

CHEMICALS 1	Ryegrass Control (%)			
	2 WAT	4 WAT	8 WAT	17 WAT
Anthem	17	63	96	78
Fierce	90	99	99	87
F9312-2	0	67	96	87
Finesse	13	60	90	85
Zidua	0	57	93	77
Valor	50	70	80	0
Check	0	0	0	0
LSD $_{(0.05)}$	9	12	3	11

[1] Anthem: (pyroxasulfon + fluthiacet [Cadet])
F9312-2: (pyroxasulfone + carfentrazone [Aim])
Fierce: (pyroxasulfone + flumioxazin [Valor])
Finesse: (chlorsulfuron [Glean] + metsulfuron [Ally])
Zidua: (pyroxasulfone)
Valor: (flumioxazin)

- Field was thoroughly tilled to prepare a seedbed. Over seeded ryegrass 11-10-11.
- Applied early post treatments on 12-9-11. Ryegrass 1-leaf stage, 0.5 to 3" tall average 1.75" tall
- Rain occurred within 5 days following application.

Table 6. **IMPACT OF EARLY POSTEMERGENCE HERBICIDES ON HENBIT CONTROL AND WHEAT INJURY. (UKREC 2011-2012)**

HERBICIDE [1]	HENBITCONTROL (%)				WHEAT INJURY (%)				WHEAT YIELD
	8 DAT	15 DAT	29 DAT	117 DAT	8 DAT	15 DAT	29 DAT	117 DAT	(BU/A)
Anthem (4.9 oz/A)	50	50	67	57	8	10	8	3	95.1
Anthem (4.9 oz/A) + NIS + AMS	50	50	63	70	10	20	17	12	88.2
Fierce (3 oz/A)	90	95	100	100	2	7	0	3	102.7
Fierce (6 oz/A)	98	98	100	100	13	20	20	23	83.8
Zidua (1.5 oz/A) + NIS + AMS	13	---	50	50	0	3	0	2	91
Valor (1 oz/A)	70	73	95	99	3	3	3	5	91.1
Valor (2 oz/A)	70	70	91	93	3	7	10	0	105.2
Valor (4 oz/A	93	92	100	100	10	13	13	3	104.8
Valor (2 oz/A) + NIS + AMS	97	99	100	100	20	27	23	17	93.7
Check	0	0	0	0	0	0	0	0	99.5
LSD $_{(0.05)}$	11	10	5	7	5	8	6	8	NS

[1] Anthem: (pyroxasulfone + fluthiacet [Cadet])
Fierce: (pyroxasulfone + flumioxazin [Valor])
Zidua: (pyroxasulfone)
Valor: (flumioxazin)

- Gramoxone Inteon applied burndown 10-10-11.
  Planted Pioneer 25R32 No-till at 37 viable seed/ft^2 10-13-11.
- Early Post 11-17-11 (Wheat 3" tall, 2 to 4 leaf stage) (Henbit 0.5 to 1" in diameter cotyledon to 2 leaf stage).