Weed Control in Pinto Beans with Imazethapyr Alone or in Combination with Other Herbicides

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ABSTRACT

Imazethapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid,) alone and in combination with other herbicides, was applied preplant incorporated, preemergence, and postemergence (PPI, PRE, POST) to pinto beans to determine weed control and selectivity to the crop. All of the herbicides improved pinto bean yield as compared with the unweeded control. Imazethapyr applied PPI and POST provided excellent control of black nightshade (*Solanum nigrum* L.), kochia (*Kochia scoparia* (L.) Schrad), Russian thistle (*Salsola iberica* Sennen & Pau), prostrate and redroot pigweed (*Amaranthus blitoides* S. Wats and *Amaranthus retroflexus* L.). Barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.) control with imazethapyr ranged from 58 to 96% and increased to 98% or better when imazethapyr was combined with metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide), pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenenamine), trifluralin (2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benenamine), or EPTC (S-ethyl dipropyl carbamothioate). Pinto bean yield was not reduced from any herbicide treatment compared to the hand-weeded control.

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Weed Control in Pinto Beans with Imazethapyr Alone or in Combination with Other Herbicides[1]

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Approximately 97% of New Mexico's pinto bean production occurs in northwestern New Mexico (2). Most of this production occurs under sprinkler irrigation on coarse-textured soils. Pinto bean growers usually preplant incorporate one or two herbicides in combination and then follow with one mechanical cultivation for annual weed control. Treflan, Eptam, and Dual applied preplant incorporated alone or in combination have been the products of choice in northwestern New Mexico. Weeds compete vigorously with dry beans, and yield reductions exceeding 70% have been recorded (1,7). Ogg et al. (3) recognized black nightshade as a serious competitor in pinto bean production and quality. Wilson et al. (5) identified redroot pigweed, kochia, nightshade spp., and barnyardgrass as serious competitors to dry beans in Nebraska. These weeds, along with prostrate pigweed and Russian thistle, are considered primary weeds that infest dry beans in northwestern New Mexico.

Many growers are not achieving effective, full-season weed control, which has led to the development of imazethapyr for weed control in dry edible beans. When applied either PPI, PRE, or POST, imazethapyr a herbicide in the imadazolinone family, effectively controlled grasses and broadleaf weeds in soybeans and other leguminous crops. Information is limited on the suitability of imazethapyr used alone or in combination with other herbicides for selective weed control in dry beans in northwestern New Mexico. The objective of this research was to evaluate weed control with and dry bean tolerance to imazethapyr applied PPI, PRE, or POST alone or in combination with other grass and broadleaf herbicides.

MATERIALS AND METHODS

Field experiments were conducted in 1989 and 1990 at the New Mexico State University Agricultural Science Center at Farmington, New Mexico, on a Kinnear very fine sandy loam (Typic Torripsamment) with a pH of 7.7 and an organic matter content of 0.3 percent. Soils were fertilized according to New Mexico State University recommendations based on soils tests. The fields were plowed, fertilized, disced, and leveled before applying herbicides and planting pinto beans. Individual plots were four rows 30-feet-long with three replications arranged in a randomized complete block design.

Pinto beans (var. UI-126) were planted on May 18, 1989 and May 21, 1990. Seed was planted with a John Deere 71 flex planter at 1.0" apart and 1.5" deep in rows spaced 34" apart. Water was supplied by solid set sprinklers.

PPI herbicides were applied on May 18, 1989 and May 21, 1990. Within 20 minutes, treatments were incorporated 2–4" deep with a tractor-driven rototiller. PRE herbicides were applied on May 23 and immediately incorporated with 0.75" of sprinkler-applied water for both 1989 and 1990. POST herbicides were combined with a nonionic surfactant (Agric-Dex) at 0.25 percent (v/v) and were applied when the crop was in the unifoliolate to first trifoliolate leaf stage. The corresponding leaf stages of black nightshade, redroot pigweed, and prostrate pigweed were two to four leaves. Leaf stages of kochia, Russian thistle, and barnyardgrass were small rosette, three to four, and two to three leaves, respectively. All treatments were applied with a com-

[1]Mention of a proprietary herbicide does not imply registration under FIFRA as amended, or endorsement by New Mexico State University.

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pressed-air sprayer mounted in the back of a John Deere AMT 622. Sprayer was calibrated to deliver 30 gallons per acre at 30 pounds per square inch. The chemical designations for the proprietary herbicides evaluated were as follows:

Common name	Trade name
EPTC	Eptam
imazethapyr	Pursuit
metolachlor	Dual
pendimethalin	Prowl
trifluralin	Treflan

Visual weed control evaluations were taken June 27 and 28, and July 25 and 26 in both 1989 and 1990. Pinto bean injury was evaluated on June 27 and 28. Visual evaluations were based on 0 percent equals no control or crop injury, and 100 percent equals dead plants. Hand-weeded controls were hand hoed as needed from June 1 until Aug. 31, during both years.

Pinto beans were harvested by hand pulling two rows each five feet long from the center of each plot on Oct. 5, 1989 and Sep. 15, 1990. Whole pinto bean plants were dried in the field for one week, thrashed with a plot thrasher, and the seed weighed. All data were subjected to analysis of variance. Treatment means were separated by Fisher's Protected LSD test at the 5% level of significance. A significant year-by-treatment interaction was found only for black nightshade and barnyardgrass visual ratings. For consistency, all data were analyzed separately for each year.

RESULTS AND DISCUSSION

Russian thistle, redroot pigweed, and kochia populations were light, averaging approximately two to three weeds per yd^2 both years (data not presented). Black nightshade populations were light with five plants per yd^2 in 1989, but populations were moderate in 1990 with approximately 10 plants per yd^2. Prostrate pigweed and barnyardgrass were the dominant weeds each year, with the unweeded control averaging approximately 35 and 20 plants per yd^2, respectively (tables 1, 2).

Table 1. Weed control with imazethapyr and imazethapyr combinations in pinto beans at Farmington, NM in 1989.

				Weed control[1,2]					
			Crop[1]	BLNS		PRPW		BYGR	
Treatments	Rate	Timing	injury	June	July	June	July	June	July
	lb ai/A			%					
imazethapyr	0.047	PPI	0	100	100	100	100	84	82
imazethapyr	0.064	PPI	3	100	100	98	100	85	82
imazethapyr	0.094	PPI	6	100	100	100	100	96	97
imazethapyr + metolachlor	0.064+1.5	PPI	2	100	100	100	100	100	100
imazethapyr + pendimethalin	0.064+0.75	PPI	3	100	100	100	100	100	100
imazethapyr + trifluralin	0.064+0.75	PPI	0	100	100	100	100	100	100
imazethapyr + EPTC	0.064+3.0	PPI	0	100	100	100	100	100	100
trifluralin + EPTC	1.0+3.0	PPI	0	100	100	100	100	100	100
imazethapyr	0.047	PRE	0	100	100	92	93	87	82
imazethapyr	0.064	PRE	2	100	100	97	97	93	86
imazethapyr + metolachlor	0.064+1.5	PRE	3	100	100	100	100	100	100
imazethapyr + pendimethalin	0.064+0.75	PRE	3	100	100	100	100	100	98
imazethapyr	0.047	POST	3	100	100	96	96	77	77
imazethapyr	0.064	POST	1	100	100	95	100	81	75
hand-weeded control			0	100	100	100	100	100	100
unweeded control			0	0	0	0	0	0	0
No. of weeds/yd^2				5	6	30	35	14	19
LSD (0.05)			1	1	1	6	4	6	6

[1]Based on a visual scale of 0–100, where 0 = no control or crop injury, and 100 = dead plants.

[2]BLNS = black nightshade, PRPW = prostrate pigweed, and BYGR = barnyardgrass.

Table 2. Weed control with imazethapyr and imazethapyr combinations in pinto beans at Farmington, New Mexico, in 1990.

Treatments	Rate	Timing	Crop[1] injury	Weed control[1,2] BLNS June	BLNS July	PRPW June	PRPW July	BYGR June	BYGR July
	lb ai/A			%					
imazethapyr	0.047	PPI	1	100	100	100	100	72	60
imazethapyr	0.064	PPI	3	100	100	98	100	77	72
imazethapyr	0.094	PPI	6	100	100	100	100	88	87
imazethapyr + metolachlor	0.064+1.5	PPI	3	100	100	100	100	100	100
imazethapyr + pendimethalin	0.064+0.75	PPI	4	100	100	100	100	100	100
imazethapyr+ trifluralin	0.064+0.75	PPI	1	100	100	100	100	100	100
imazethapyr + EPTC	0.064+3.0	PPI	1	100	100	100	100	100	100
trifluralin + EPTC	1.0+3.0	PPI	0	88	83	100	100	100	100
imazethapyr	0.047	PRE	0	100	100	87	96	73	68
imazethapyr	0.064	PRE	3	100	100	92	98	87	83
imazethapyr + metolachlor	0.064+1.5	PRE	4	100	100	100	100	100	100
imazethapyr + pendimethalin	0.064+0.75	PRE	3	100	100	100	100	100	100
imazethapyr	0.047	POST	4	100	100	96	96	58	52
imazethapyr	0.064	POST	1	100	100	97	100	62	62
hand-weeded control			0	100	100	100	100	100	100
unweeded control			0	0	0	0	0	0	0
No. of weeds/yd^2				10	10	37	37	23	23
LSD (0.05)			2	1	1	4	1	5	4

[1]Based on a visual scale of 0–100, where 0 = no control or crop injury, and 100 = dead plants.

[2]BLNS = black nightshade, PRPW = prostrate pigweed, and BYGR = barnyardgrass.

Imazethapyr PPI and PRE at 0.047 lb ai/A, and PPI 0.064 lb ai/A, imazethapyr in combination with 0.75 lb ai/A trifluralin or 3.0 lb ai/A EPTC caused less than 3% pinto bean injury (tables 1, 2). Imazethapyr PPI at 0.094 lb ai/A showed minimal stunting and had the highest injury rating of 6%. Imazethapyr PPI at 0.064 lb ai/A in combination with metolachlor at 1.5 or pendimethalin at 0.75 lb ai/A injured beans 2 to 4%. Injury ratings of imazethapyr PRE at 0.064 lb ai/A alone or in combination with metolachlor or pendimethalin were similar to those herbicides PPI. Imazethapyr POST at 0.047 lb ai/A caused more injury than the 0.064 lb ai/A rate. However, Renner and Powell (4) reported that imazethapyr POST at 0.064 lb ai/A injured pinto beans by 20%. Wilson and Miller (6) found that there was a trend for greater pinto bean injury from imazethapyr applied PPI or PRE than POST.

Visual assessment in June and July indicated that all herbicide treatments controlled 100% of Russian thistle, kochia, and redroot pigweed both years (data not presented). In 1989, black nightshade control was excellent with all treatments. Trifluralin plus EPTC at 1.0 plus 3.0 lb ai/A was the only treatment that did not give 100% control of black nightshade in 1990 (tables 1, 2). Depth of incorporation may have been responsible for reduced black nightshade control when compared to 1989. Black nightshade control with this treatment decreased approximately 5% from June to July. Only treatments including imazethapyr controlled black nightshade up to July (table 2).

All treatments controlled 87% or more of prostrate pigweed (tables 1, 2). Imazethapyr PPI at 0.047 lb ai/A controlled prostrate pigweed better than PRE and POST treatments, except for July 1990. The addition of metolachlor or pendimethalin at 1.5 and 0.75 lb ai/A, respectively, to 0.064 lb ai/A imazethapyr PRE increased prostrate pigweed control 3 to 8%.

Imazethapyr controlled 3 to 25% more barnyardgrass in 1989 than 1990 (tables 1, 2). Barnyardgrass populations increased from 1989 to 1990. Imazethapyr combined with other herbicides controlled 100% of barnyardgrass. Imazethapyr PRE at 0.064 lb ai/A con-

trolled barnyardgrass better than PPI and POST treatments, except in July 1989.

Weeds were strong competitors with pinto beans, reducing yields by 60 and 66% in 1989 and 1990, respectively (table 3). All herbicide treatments both years produced pinto bean yields equal to that of the unweeded controls, suggesting good tolerance of this pinto bean to imazethapyr. In 1989, trifluralin plus EPTC, and imazethapyr at 0.064 lb ai/A plus EPTC, and imazethapyr alone PPI at 0.047 lb ai/A produced more beans than imazethapyr PRE or POST at 0.047 lb ai/A and PRE 0.064 lb ai/A, possibly reflecting reduced barnyardgrass control. In 1990, however, yields of PRE and POST imazethapyr treatments were not reduced compared to other herbicide treatments. Yield losses below 16% (1989) and 12% (1990) could not be detected due to variance in the field.

The results of this study emphasize the need for good weed control to attain optimum pinto bean yields. Imazethapyr provided as good or better control of broadleaf weeds as trifluralin plus EPTC. Results indicate that barnyardgrass control with imazethapyr was marginal, although pinto bean yield was not reduced both years. Imazethapyr in combination with metolachlor, pendimethalin, trifluralin, or EPTC gave excellent control of all weeds in this study, including barnyardgrass.

Table 3. Yield of pinto beans treated with imazethapyr and imazethapyr combinations at Farmington, New Mexico, in 1989 and 1990.

Treatments	Rate	Timing	Yield	
			1989	1990
	lb ai/A		lb/A	
imazethapyr	0.047	PPI	4968	4041
imazethapyr	0.064	PPI	4612	4201
imazethapyr	0.094	PPI	4558	4094
imazethapyr + metolachlor	0.064+1.5	PPI	4817	4558
imazethapyr + pendimethalin	0.064+0.75	PPI	4505	4558
imazethapyr + trifluralin	0.064+0.75	PPI	4763	4505
imazethapyr + EPTC	0.064+3.0	PPI	5022	4451
trifluralin + EPTC	1.0+3.0	PPI	5022	4353
imazethapyr	0.047	PRE	4201	4148
imazethapyr	0.064	PRE	4094	4094
imazethapyr + metolachlor	0.064+1.5	PRE	4406	4558
imazethapyr + pendimethalin	0.064+0.75	PRE	4451	4612
imazethapyr	0.047	POST	4246	4201
imazethapyr	0.064	POST	4558	4343
hand-weeded control			4817	4451
unweeded control			1945	1534
LSD 0.05			731	544

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