

Department of
Entomology, Plant Pathology & Weed Science

ABSTRACT

A five-year study was conducted from 1999–2003 at the New Mexico State University Agricultural Science Center at Farmington, NM to evaluate postemergence herbicides for control of redroot and prostrate pigweed, black nightshade, common lambsquarters, and Russian thistle and their effect on alfalfa injury, yield, and quality. In 1999 and 2001, treatments gave 92 to 100 percent control of black nightshade, common lambsquarters, and Russian thistle. However, in 2000, treatments were less effective. Control of Russian thistle using Raptor at 0.032 and Pursuit at 0.047 lb ai/A was 28 to 30 percent less effective in 2000 than was the same regime in 1999 and 2001. In 2000 and 2001, Buctril alone at 0.25 lb ai/A or in combination with Select at 0.094 lb ai/A gave poor control of redroot and prostrate pigweed. In 2002 and 2003, however, control of Russian thistle increased approximately from 7 to 12 percent using Raptor at 0.032, 0.04 and 0.047 lb ai/A in combination with Buctril at 0.25 lb ai/A as compared to single applications of Raptor alone. Yields of Legend, RSC 451, and WL 325 from 1999–2001 and 2002–2003 averaged 1.9, 2.6 and 2.2 tons/A, respectively. In 2002–2003, RSC 451 consistently outproduced WL 325 by approximately 0.1 to 0.8 tons/A. From 1999–2001, Legend Relative Feed Values (RFV) ranged from 128 to 184 among herbicide treatments. The weedy check in 1999 and 2000 had a higher RFV than did samples treated with Raptor alone at 0.047 lb ai/A, Raptor alone at 0.032 lb ai/A or in combination with Buctril or Poast at 0.25 and 0.19 lb ai/A, or Pursuit and Buctril alone at 0.063 and 0.25 lb ai/A. In 2002–2003, RFVs among herbicide treatments for RSC 451 and WL 325 averaged approximately 176 and 170. In 1999–2001 and 2002–2003, Legend, RSC 451 and WL 325 alfalfa averaged protein content of 21.4, 20.3 and 20.1 percent, respectively, among all herbicide treatments. RSC 451 injury (crop stunting) with Raptor at 0.063 lb ai/A did have the lowest RFV and percent protein content in 2002 and one of the lowest yields among herbicide treatments of Legend alfalfa in 2003.

INTRODUCTION

Alfalfa is one of the most important forage legumes cultivated in the United States (4, 8). In New Mexico, alfalfa is the leading forage cash crop, accounting for approximately 20% of the state's income from agricultural products. Approximately 240,000 acres of alfalfa are harvested annually in New Mexico. San Juan County ranks first in District 10 and fourth among all counties in total harvested acreage (11). Controlling weeds during the establishment year is important for decreasing competition with alfalfa and for increasing alfalfa yield and quality (2, 7). Weeds compete with alfalfa for water, nutrients and light. Weeds cause immediate problems as well as future problems in alfalfa (10). Herbicide use reduces weed densities and allows better stands of pure alfalfa to be obtained in the seeding year (9, 13). Excellent weed control can make the difference between profit and loss.

Redroot and prostrate pigweed, black nightshade, Russian thistle and common lambsquarters are annual broadleaf weeds that infest seedling alfalfa causing increased yields but decreased quality values (1). Pursuit (imazethapyr) and Raptor (imazamox) of the imidazolinone herbicide family (6) were registered in 1995 and 2002 respectively for broadleaf weed control in seedling alfalfa.

The objectives of this five year study were to determine (a) herbicide efficacy of Pursuit and Raptor applied alone or in combination for control of broadleaf weeds in spring-seeded alfalfa and (b) their effect on alfalfa yield and quality. Chemical and proprietary names of herbicides applied to spring seeded alfalfa from 1999–2003 are given in Table 1.

MATERIALS AND METHODS

Field experiments were conducted from 1999–2003 at New Mexico State University Agricultural Science Center at Farmington, NM to evaluate the response of seedling alfalfa and annual broadleaf weeds to postemergence applications of Raptor or Pursuit applied alone or in combination. Soil was a Doak silt loam (fine-silty, mixed, mesic Typic Haplargid) with a pH of 7.4 and organic matter content of less than 0.5 percent. The fields were ripped to a depth of 12 inches, fertilized before planting with 20 N, 50 P205, 60 K20 lb/A, disked, and leveled before planting and herbicide application.

¹College Professor; College Associate Professor; Associate Professor and Superintendent; and Research Specialist, respectively, Agricultural Science Center at Farmington, New Mexico.

Table 1. Chemical and proprietary names of herbicides applied to spring-seeded alfalfa at Farmington, New Mexico 1999-2003.

Common Name	Trade Name	Chemical Name
Imazethapyr	Pursuit 2AS	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid
Imazamox	Raptor 1AS	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid
Bromoxynil	Buctril 4EC	3,5-dibromo-4-hydroxybenzotrile
Sethoxydim	Poast 1.5EC	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
Clethodim	Select 2EC	(E,E)-(+)-2-[1-[[3-(chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
2,4-DB	Butyrac 200	4-(2,4-dichlorophenoxy)butanoic acid
COC	Crop oil concentrate containing at least 83 percent paraffin base petroleum oil.	
MSO	Methylated seed oil containing 100 percent methylated vegetable oil, alcohol ethylate, and tall oil fatty acid.	
NIS	Non-ionic surfactant containing at least 80 percent alkyl polyethoxy ethers.	
32-0-0	A solution mixture of urea and ammonium nitrate with water.	

Alfalfa varieties of Legend, RSC 491, and WL 325 were planted from 1999–2001, 2002, and 2003 with a Massey Ferguson grain drill at 20 lbs/A. Alfalfa varieties were planted at a depth of less than 0.5 inch, during the third week of May.

Herbicide treatments were applied with a compressed air backpack sprayer equipped with XR 11004-VS nozzles and calibrated to deliver 30 gal/A at 40 psi. Treatments were applied postemergence on June 16, 1999, June 12, 2000 and 2001, June 4, 2002 and June 5, 2003 when alfalfa varieties were in the second trifoliolate leaf stage and weeds were small (less than 2 inches). Redroot and prostrate pigweed, black nightshade, and common lambsquarters infestations were heavy, averaging 20, 23, 26, and 19 plants/yard², respectively, Russian thistle infestations were light, averaging 6 plants/yard², throughout the experimental area from 1999–2003.

Visual evaluations for crop injury and weed control were made on July 15, 1999, July 12, 2000 and 2001, July 9, 2002 and July 10, 2003. Percentage crop injury and percentage weed control were estimated visually for each treatment by comparison to the weedy check, with 0 indicating no injury or no weed control and 100 indicating dead alfalfa plants or dead weeds.

Alfalfa was generally harvested each year at first bloom with an Almaco plot harvester equipped with a load cell. A 4.2 by 30 ft area was harvested from the center of each plot and weighed. A random grab sample weighing approximately 2.0 lb was taken from each plot. The sample was oven-dried and ground in a Udy cyclone mill to pass through a 20 mesh screen. Percent crude protein and relative feed value were assessed by Nitrogen Determination by Combustion Method (12) and Determination of Acid Detergent Fiber by Refluxing (5). Alfalfa and weeds were not separated prior to analysis. Protein percentage and relative feed values are expressed for an alfalfa and weed mixture.

During each year, the experimental design was a randomized complete block with four replications. Years 1999–2001 were not combined because different herbicide combinations were used. In 2002 and 2003, weed control and crop injury data were combined with years as main plots and herbicide treatments as subplots. Yields, protein content and relative feed values were not analyzed separately. All data were subject-

ed to analysis of variance, and treatment means were separated by the Fisher's (protected) LSD test at the 5 percent level of significance (3).

RESULTS AND DISCUSSION

Weed Control Efficacy and Crop Injury, 1999–2001. Raptor plus Buctril at 0.024 plus 0.25 lb ai/A had the highest injury rating of all treatments of 5 percent in 1999 (Table 2) as compared to no injury with the higher rate of Raptor plus Buctril at 0.032 plus 0.25 lb ai/A in 2001 (Table 4). Black nightshade control from 1999–2001 was good to excellent with all treatments except the weedy check, ranging from 94 to 100 percent (Tables 2, 3 and 4). Buctril applied alone at 0.25 lb ai/A in 2000 or in combination with Select at 0.094 lb ai/A in 2001 gave poor control of redroot and prostrate pigweed (Tables 3 and 4). However, Buctril in combination with Poast applied at 0.25 plus 0.19 lb ai/A in 1999 gave approximately 53 to 82 percent better control of redroot and prostrate pigweed (Table 2) than did Buctril alone at 0.25 lb ai/A in 2000 or in combination with Select, at 0.25 plus 0.094 lb ai/A, in 2001 (Tables 3 and 4). The poor control of redroot and prostrate pigweed with Buctril alone or in combination with Select in 2000 and 2001 may be attributed to environmental factors such as weed height and/or spray coverage. Russian thistle control in 1999 and 2001 was excellent with all treatments except the weedy check (Tables 2 and 4). In 2000, however, Raptor and Pursuit applied alone at 0.032 and 0.047 lb ai/A or in combination with Select at 0.094 lb ai/A (Table 3) only gave 70, 83 and 85 percent control of Russian thistle. Common lambsquarters control in 1999 and 2001 was excellent with all treatments except the weedy check (Tables 2 and 4). Raptor applied alone at 0.032, 0.04 or 0.047 lb ai/A with methylated seed oil (MSO) plus 32-0-0 at 1.0 percent volume/volume (v/v) gave approximately 11, 5 and 3 percent better control, respectively, of common lambsquarters than did those same treatments with a non-ionic surfactant plus 32-0-0 applied at 0.25 plus 1.0 percent v/v., respectively (Table 3). In 2000, Pursuit applied at 0.047

lb ai/A alone or in combination with Poast at 0.19 lb ai/A gave fair control (83 and 84 percent, respectively) of common lambsquarters (Table 3).

Weed Control Efficacy and Crop Injury, 2002–2003.

Raptor applied at 0.063 lb ai/A resulted in the highest crop injury of 12 percent when averaged over both varieties (Table 5). Control of black nightshade, redroot and prostrate pigweed and common lambsquarters was greater than 95 percent with all treatments except the weedy check (Table 5). Russian thistle control was 86 percent or greater with all treatments except the weedy check. Raptor applied at 0.032, 0.04, and 0.047 lb ai/A in combination with Buctril at 0.025 lb ai/A gave 99 and 100 percent control of Russian thistle (Table 5). The lower rates of Raptor and Pursuit at 0.032 and 0.047 lb ai/A, respectively, decreased Russian thistle control by approximately 5 percent when compared to Raptor at 0.04 and 0.047 lb ai/A and Pursuit at 0.063 lb ai/A (Table 5). Herbicide treatment combinations of Raptor and Pursuit at 0.024 and 0.032 lb ai/A gave approximately one to three percent better weed control than did the single applications of Raptor and Pursuit (Table 5). Over a nine year period from 1985 to 1994, Miller and Ogg (10) found similar weed control results with Pursuit applied at 0.063 lb ai/A for control of redroot pigweed, black nightshade, common lambsquarters and Russian thistle.

Alfalfa Yield, 1999–2001. Yields of Legend alfalfa in 1999, 2000, and 2001 ranged from 1.3 to 1.8, from 1.8 to 2.6, and from 2.0 to 3.1 tons/A respectively, among all herbicide treatments (Tables 6, 7 and 8). In 2000 Buctril alone at 0.25 lb ai/A or in combination with Select at 0.025 plus 0.094 lb ai/A (2001) had the highest yield among herbicide treatments of 2.6 and 3.1 tons/A, respectively. However, these two treatments gave poor control of redroot and prostrate pigweed (Tables 3 and 4), resulting in a weed and alfalfa mixture that increased total green weight when harvested. In each of the three years the weedy check, consisting of an alfalfa weed mixture, had the highest yield among the samples: 2.2 in 1999, 3.7 in 2000 and 3.5 tons/A in 2001 (Tables 6, 7 and 8). The average yields of Legend alfalfa among herbicide treatments in 1999, 2000, and 2001 were 1.5, 2.0 and 2.2 tons/A, respectively. The overall average for 1999–2001 was 1.9 tons/A.

Relative Feed Value, 1999–2001. Relative feed values (RFV) of Legend alfalfa were not consistent among similar treatments from year to year and ranged from 128 to 184, 119 to 157, and 123 to 165 among herbicide treatments from 1999 to 2001 (Tables 6, 7 and 8). In 1999, Raptor alone at 0.024 lb ai/A and Raptor alone or in combination with Buctril at 0.04 plus 0.25 lb ai/A had the highest RFV at 182 and 184, respectively (Table 6). In 2000 and 2001, Raptor plus Select at 0.032 plus 0.094 lb ai/A, (Table 7) and Raptor or Pursuit alone at 0.032 and 0.063 lb ai/A, (Table 8) yielded some of the highest RFVs among herbicide treatments 157 and 165, respectively. In both years Buctril alone at 0.25 lb ai/A or in combination with Select at 0.094 lb ai/A had the lowest RFVs among herbicide treatments 119 and 123, respectively, indicating that the sample contained a mixture of alfalfa and redroot and prostrate pigweed taken during sampling (Tables 7 and 8). The average RFVs of Legend alfalfa

among herbicide treatments from 1999–2001 were 159, 142 and 150, respectively. The overall RFV average for Legend alfalfa during the three-year period was 150.

Protein Content, 1999–2001. During the years 1999–2001 percent protein content of Legend alfalfa ranged from 13.3 to 24.8 (Tables 6, 7 and 8). Again, as with RFVs in 2000 and 2001, Buctril alone at 0.25 lb ai/A or in combination with Select at 0.0.094 lb ai/A yielded the lowest percent protein content, 14.3 and 13.3 percent, respectively (Tables 7 and 8). During these years, the amount of weeds harvested with the weedy check decreased protein content from 0.7 to 11.3 percent (Tables 6, 7 and 8). The average percent protein contents of Legend alfalfa among all herbicide treatments in the years 1999, 2000, and 2001 were 21.7, 21.1 and 21.3, respectively. The overall three-year average for percent protein content was 21.4.

Alfalfa Yield, 2002–2003. In 2002 and 2003, yields of RSC 451 and WL 325 alfalfa ranged from 2.3 to 3.1 and 1.9 to 2.6 tons/A, respectively, among herbicide treatments (Tables 9 and 10). In 2002, the combination treatment of Pursuit plus Select at 0.063 plus 0.094 lb ai/A was the highest yielding among herbicide treatments at 3.1 tons/A (Table 9). In 2003, the combination treatment of Raptor plus Pursuit at 0.024 plus 0.024 lb ai/A was the highest yielding among herbicide treatments at 2.6 tons/A (Table 10). With both alfalfa varieties having the same treatments applied during 2002–2003, RSC 451 consistently outproduced WL 325 by about 0.1 to 0.8 tons/A. However, Pursuit at 0.047 lb ai/A gave the same yield for both RSC 451 and WL 325, 2.5 tons/A (Tables 9 and 10).

Relative Feed Value, 2002–2003. Relative feed value (RFV) for RSC 451 and WL 325 in 2002 and 2003 ranged from 145 to 207 and 139 to 196, respectively, among herbicide treatments (Tables 9 and 10). In 2002, Raptor at 0.04 lb ai/A in combination with Select at 0.094 and Pursuit alone at 0.047 had the highest RFV of 207 (Table 9). The lowest RFVs of 145 and 147 resulted from, respectively, treatments of Raptor alone at 0.063 lb ai/A and Raptor at 0.032 in combination with Select or Buctril at 0.094 and 0.25 lb ai/A (Table 9). In 2003, Raptor at 0.047 and 0.04 lb ai/A had the highest and lowest RFVs of 196 and 139, respectively (Table 10). RFV of RSC 451 and WL 325 RFV averaged 176 and 170, respectively, among herbicide treatments for both years. Furthermore, the RFV of the weedy check for both varieties was lowest among all treatments at 130 for RSC 451 and 138 for WL 325 (Tables 9 and 10).

Protein Content, 2002–2003. Percent protein content of RSC 451 and WL 325 ranged from 15.0 to 23.9 and 17.5 to 23.2, respectively, among herbicide treatments. The reduction in percent protein content in the weedy check as compared to other treatments ranged from 1.8 to 10.7 percent for RSC 451 and from 3.3 to 9.0 percent for WL 325 (Tables 9 and 10). The average percent protein content for RSC 451 and WL 325 among herbicide treatments was 20.3 and 20.1 percent, respectively.

CONCLUSIONS

Raptor at 0.063 lb ai/A had the highest alfalfa injury rating of 12 percent. Black nightshade and common lambsquarters control was good to excellent with all treatments except the weedy check. In 2000 and 2001 redroot and prostrate pigweed control was good to excellent among herbicide treatments except for Buctril applied alone at 0.25 lb ai/A or in combination with Select at 0.094 lb ai/A. Furthermore, Russian thistle control with Raptor 0.032 or Pursuit at 0.047 lb ai/A decreased in 2000 as compared to other years. Environmental factors such as weed height and spray coverage during application may have caused the poor control of redroot and prostrate pigweed with Buctril alone or in combination with Select, and decreased control of Russian thistle with Raptor and Pursuit. In 2000, Raptor treatments with MSO plus 32-0-0 improved common lambsquarters control approximately from 3 to 11 percent in comparison to those same treatments applied with a non-ionic surfactant and 32-0-0. Yields of Legend alfalfa ranged from 1.3 to 3.1 tons/A among herbicide treatments from 1999 to 2001. In 2002 and 2003,

with the same herbicide treatments applied to RSC 451 and WL 325, RSC 451 consistently outproduced WL 325. In 1999, Pursuit at 0.063 lb ai/A, Raptor at 0.032 and 0.047 lb ai/A, and Raptor at 0.032 and 0.024 lb ai/A in combination with either Buctril or Poast at 0.25 and 0.19 lb ai/A were the only herbicide treatments that had a lower RFV than the weedy check. In 2000, Buctril at 0.25 lb ai/A was the only herbicide treatment with a RFV lower than the weedy check. From 1999 to 2003 protein content among alfalfa varieties and herbicide treatments ranged from 24.8 to 13.2 percent

These studies have shown that an alfalfa producer using Raptor or Pursuit treatments alone or in combination with either Butyrac 200, Poast, Select or Buctril can achieve 92 percent or better control of black nightshade, redroot and prostrate pigweed, and common lambsquarters during the establishment year. However, Raptor and/or Pursuit should be tank mixed with Buctril for effective control of Russian thistle. Without the use of these herbicides during the establishment year, broadleaf weed control and alfalfa quality would be reduced.

Table 2. Control of annual broadleaf weeds with postemergence applications of Raptor and Pursuit alone or in combination in spring-seeded Legend alfalfa, July 15, 1999 at Farmington, New Mexico.

Treatments ^a	Rate (lb/ai/A)	Crop Injury ^b (%)	-----Weed Control ^{b,c} -----				
			Solni	Amare	Amabl	Saskr	Cheal
Raptor	0.024	0	94	100	100	98	99
Raptor	0.032	0	100	100	100	98	100
Raptor	0.040	1	100	100	100	100	100
Raptor	0.047	4	100	100	100	100	100
Raptor + Buctril	0.024+0.25	5	100	100	100	100	100
Raptor + Butyrac 200	0.024+0.5	0	100	100	100	100	100
Raptor + Buctril	0.032+0.25	0	100	100	100	100	100
Raptor + Butyrac 200	0.032+0.5	0	100	100	100	100	100
Raptor + Buctril	0.04+0.25	0	100	100	100	100	100
Raptor + Butyrac 200	0.04+0.5	4	100	100	100	100	100
Pursuit	0.063	2	100	100	100	100	100
Pursuit	0.047	0	97	100	100	100	100
Buctril + Poast	0.25+0.19	0	97	93	92	100	100
Butyrac 200 + Poast	0.5+0.19	0	100	98	100	100	100
Raptor + Poast	0.024+0.19	0	97	98	100	100	100
Weedy check		0	0	0	0	0	0
Approx. weeds/Yd ²			27	18	19	6	19
LSD 0.05		2	3	1	1	1	1

^aAll treatments applied with a NIS and 32-0-0 at 0.25% and 1.0% v/v. Poast combinations were applied with a COC and 32-0-0 at 1.0% v/v.

^bBased on a visual scale from 0-100 where, 0 indicates no control or crop injury and 100 indicates dead plants.

^cSOLNI-black nightshade, AMARE-redroot pigweed, AMABL-prostrate pigweed, SASKR-Russian thistle, and CHEAL-common lambsquarters.

Table 3. Control of annual broadleaf weeds with postemergence applications of Raptor and Pursuit alone or in combination in spring-seeded Legend alfalfa, July 12, 2000 at Farmington, New Mexico.

Treatments	Rate (lb/ai/A)	Crop Injury ^a (%)	-----Weed Control ^{b,c} -----				
			Solni	Amare	Amabl	Saskr	Cheal
			------(%)-----				
Raptor ^c	0.032	0	100	100	100	70	89
Raptor ^c	0.04	0	100	100	100	92	95
Raptor ^c	0.047	0	100	100	100	97	97
Raptor ^d	0.032	0	100	100	100	96	100
Raptor ^d	0.04	0	100	100	100	100	100
Raptor ^d	0.047	0	100	100	100	95	99
Pursuit ^d	0.047	0	100	100	100	70	83
Pursuit ^d	0.063	0	100	100	100	92	95
Pursuit + Select ^d	0.047+0.094	0	100	100	100	85	98
Pursuit + Select ^d	0.063+0.094	0	100	100	100	98	98
Raptor + Select ^d	0.032+0.094	0	100	100	100	83	98
Raptor + Poast ^d	0.032+0.19	0	100	100	100	96	100
Pursuit + Poast ^d	0.047+0.19	0	100	100	100	98	84
Pursuit + Poast ^d	0.063+0.19	0	100	100	100	95	93
Buctril ^c	0.25	0	100	40	65	100	96
Weedy check		0	0	0	0	0	0
Approx. weeds/Yd ²			24	21	28	5	20
LSD 0.05			1	12	8	6	7

^aBased on a visual scale from 0 to 100, where 0 indicates no control or crop injury and 100 indicates dead plants.

^bSOLNI-black nightshade, AMARE-redroot pigweed, AMABL-prostrate pigweed, SASKR-Russian thistle, and CHEAL-common lambsquarters.

^cTreatments applied with an NIS and 32-0-0 at 0.25% and 1% v/v.

^dTreatments applied with an MSO and 32-0-0 at 1.0% v/v.

Table 4. Control of annual broadleaf weeds with postemergence applications of Raptor and Pursuit applied alone or in combination in spring-seeded Legend alfalfa, July 12, 2001 at Farmington, New Mexico.

Treatments ^a	Rate (lb/ai/A)	Crop Injury ^b (%)	-----Weed Control ^{b,c} -----				
			Solni	Amare	Amabl	Saskr	Cheal
			------(%)-----				
Raptor	0.032	0	100	100	100	100	100
Raptor	0.047	0	100	100	100	100	100
Raptor + Buctril	0.032+0.25	0	98	98	100	100	100
Raptor + Buctril	0.04+0.25	0	100	98	100	100	100
Raptor + Buctril	0.047+0.25	0	100	96	100	100	100
Raptor + Butyrac 200	0.032+0.5	0	100	100	100	100	100
Raptor + Butyrac 200	0.047+0.5	0	100	100	100	100	100
Raptor + Butyrac 200	0.04+0.5	0	100	100	100	97	100
Pursuit + Buctril	0.063+0.25	0	100	97	100	100	100
Pursuit + Butyrac 200	0.063+0.5	0	100	98	100	100	100
Pursuit	0.063	0	100	100	100	100	98
Raptor + Select	0.032+0.094	0	100	100	100	100	100
Raptor + Select	0.04+0.094	0	100	100	100	100	100
Pursuit + Select	0.063+0.094	0	100	98	100	100	100
Buctril + Select	0.25+0.094	0	100	10	10	100	98
Weedy check		0	0	0	0	0	0
Approx. weeds/Yd ²			23	20	24	7	17
LSD 0.05			1	3	2	2	1

^aTreatments applied with a COC at 1% v/v and AMS at 5 lb/A.

^bBased on visual scale from 0 to 100, where 0 indicates no control or crop injury and 100 indicates dead plants.

^cSOLNI-black nightshade, AMARE-redroot pigweed, AMABL-prostrate pigweed, SASKR-Russian thistle, and CHEAL-common lambsquarters.

Table 5. Control of annual broadleaf weeds with postemergence applications of Raptor and Pursuit applied alone or in combination in spring-seeded RSC 491 and WL 325 alfalfa, July 9 and July 10, 2002–2003 at Farmington, New Mexico.

Treatments ^a	Rate (lb/ai/A)	Crop Injury ^b (%)	-----Weed Control ^{b,c} -----				
			Solni	Amare	Amabl	Saskr	Cheal
Raptor	0.032	0	97	98	97	88	97
Raptor	0.04	0	99	99	99	92	99
Raptor	0.047	0	100	100	100	93	98
Raptor	0.063	12	100	100	99	94	98
Raptor + Pursuit	0.024+0.024	0	96	100	100	86	95
Raptor + Pursuit	0.032+0.032	0	100	100	99	91	98
Raptor + Bucril	0.032+0.25	1	99	99	100	99	99
Raptor + Bucril	0.04+0.25	1	100	100	100	100	99
Raptor + Bucril	0.047+0.25	1	100	100	100	100	100
Raptor + Select	0.032+0.094	0	96	99	98	91	97
Raptor + Select	0.04+0.094	0	99	100	99	92	97
Raptor + Select	0.047+0.094	0	100	99	100	92	98
Pursuit	0.047	0	98	99	100	87	95
Pursuit	0.063	0	99	99	100	92	98
Pursuit + Select	0.063+0.094	0	100	100	100	91	98
Weedy check		0	0	0	0	0	0
Approx. weeds/Yd ²			30	22	21	7	20
LSD 0.05		1	1	1	1	2	1

^aTreatments applied with COC and 32-0-0 at 0.5% and 1.0% v/v.

^bBased on visual scale from 0 to 100, where 0 indicates no control or crop injury and 100 indicates dead plants.

^cSOLNI-black nightshade, AMARE-redroot pigweed, AMABL-prostrate pigweed, SASKR-Russian thistle, and CHEAL-common lambsquarters.

Table 6. Yield, relative feed value and protein content of Legend alfalfa, August 16, 1999 at Farmington, New Mexico.

Treatments ^a	Rate (lb/ai/A)	Yield Tons/A	Relative Feed Value (no)	Protein Content (%)
Raptor	0.024	1.4	182	23.0
Raptor	0.032	1.6	141	20.9
Raptor	0.040	1.3	160	21.6
Raptor	0.047	1.4	140	19.8
Raptor + Bucril	0.024+0.25	1.5	176	22.3
Raptor + Butyrac 200	0.024+0.5	1.4	169	22.6
Raptor + Bucril	0.032+0.25	1.6	145	20.5
Raptor + Butyrac 200	0.032+0.5	1.5	166	22.7
Raptor + Bucril	0.04+0.25	1.6	184	24.8
Raptor + Butyrac 200	0.04+0.5	1.5	170	22.7
Pursuit	0.063	1.5	143	19.4
Pursuit	0.047	1.5	151	21.2
Bucril + Poast	0.25+0.19	1.6	155	21.4
Butyrac 200 + Poast	0.5+0.19	1.6	173	24.0
Raptor + Poast	0.024+0.19	1.8	128	18.1
Weedy check		2.2	147	17.4
LSD 0.05		0.5	19	2.0

^aAll treatments applied with a NIS and 32-0-0 at 0.25% and 1.0% v/v. Poast combinations were applied with a COC and 32-0-0 at 1.0% v/v.

Table 7. Yield, relative feed value and protein content of Legend alfalfa, August 1, 2000 at Farmington, New Mexico.

Treatments	Rate (lb/ai/A)	Yield Tons/A	Relative Feed Value (no)	Protein Content (%)
Raptor ^a	0.032	2.0	137	20.5
Raptor ^a	0.04	1.9	138	21.2
Raptor ^a	0.047	2.0	141	21.1
Raptor ^b	0.032	1.8	156	22.5
Raptor ^b	0.04	1.9	136	21.2
Raptor ^b	0.047	2.0	152	22.1
Pursuit ^b	0.047	2.2	139	21.0
Pursuit ^b	0.063	1.9	142	21.0
Pursuit + Select ^b	0.047+0.094	2.1	137	21.7
Pursuit + Select ^b	0.063+0.094	1.9	143	21.6
Raptor + Select ^b	0.032+0.094	2.0	157	21.7
Raptor + Poast ^b	0.032+0.19	1.9	146	22.9
Pursuit + Poast ^b	0.047+0.19	2.1	149	22.5
Pursuit + Poast ^b	0.063+0.19	2.3	138	21.6
Bucril ^a	0.25	2.6	119	14.3
Weedy check		3.7	120	11.6
LSD 0.05		0.8	12	2.1

^aTreatments applied with an NIS and 32-0-0 at 0.25% and 1% v/v.

^bTreatments applied with an MSO and 32-0-0 at 1.0% v/v.

Table 8. Yield, relative feed value and protein content of Legend alfalfa, August 9, 2001 at Farmington, New Mexico.

Treatments ^a	Rate (lb/a)	Yield Tons/A	Relative Feed Value (no)	Protein Content (%)
Raptor	0.032	2.1	165	21.5
Raptor	0.047	2.1	160	21.2
Raptor + Bucril	0.032+0.25	2.2	148	21.6
Raptor + Bucril	0.04+0.25	2.0	156	22.5
Raptor + Bucril	0.047+0.25	2.2	147	22.2
Raptor + Butyrac 200	0.032+0.5	2.2	152	22.3
Raptor + Butyrac 200	0.047+0.5	2.0	160	21.4
Raptor + Butyrac 200	0.04+0.5	2.2	142	21.9
Pursuit + Bucril	0.063+0.25	2.1	147	22.0
Pursuit + Butyrac 200	0.063+0.5	2.2	143	21.6
Pursuit	0.063	2.1	165	21.7
Raptor + Select	0.032+0.094	2.1	146	22.5
Raptor + Select	0.04+0.094	2.3	149	22.5
Pursuit + Select	0.063+0.094	2.0	142	21.9
Bucril + Select	0.25+0.094	3.1	123	13.3
Weedy check		3.5	112	11.6
LSD 0.05		0.7	11	1.2

^aTreatments applied with a COC at 1.0% v/v and AMS at 5 lb/A.

Table 9. Yield, relative feed value and protein content of RSC 451 spring-seeded alfalfa sprayed with postemergence applications of Raptor and Pursuit applied alone or in combination, July 29, 2002 at Farmington, New Mexico.

Treatments ^a	Rate (lb/a)	Yield Tons/A	Relative Feed Value (no)	Protein Content (%)
Raptor	0.032	2.7	170	18.6
Raptor	0.04	2.7	179	20.3
Raptor	0.047	2.5	177	19.7
Raptor	0.063	2.6	145	15.0
Raptor + Pursuit	0.024+0.024	2.8	157	18.9
Raptor + Pursuit	0.032+0.032	2.5	160	19.5
Raptor + Bucril	0.032+0.25	2.5	188	22.5
Raptor + Bucril	0.04+0.25	2.5	190	23.9
Raptor + Bucril	0.047+0.25	2.3	189	22.7
Raptor + Select	0.032+0.094	2.5	147	16.9
Raptor + Select	0.04+0.094	2.5	207	23.1
Raptor + Select	0.047+0.094	2.7	172	20.1
Pursuit	0.047	2.5	207	22.4
Pursuit	0.063	2.6	185	22.1
Pursuit + Select	0.063+0.094	3.1	164	19.3
Weedy check		3.8	130	13.2
LSD 0.05		0.4	12	1.5

^aTreatments applied with COC and 32-0-0 at 0.5% and 1.0% v/v.

Table 10. Yield, relative feed value and protein content of WL 325 spring-seeded alfalfa sprayed with postemergence applications of Raptor and Pursuit applied alone or in combination, August 4, 2003 at Farmington, New Mexico.

Treatments ^a	Rate (lb/a)	Yield Tons/A	Relative Feed Value (no)	Protein Content (%)
Raptor	0.032	2.3	170	20.3
Raptor	0.04	2.3	139	19.3
Raptor	0.047	2.2	196	20.8
Raptor	0.063	2.0	155	20.3
Raptor + Pursuit	0.024+0.024	2.6	160	19.7
Raptor + Pursuit	0.032+0.032	2.3	152	19.5
Raptor + Bucril	0.032+0.25	2.1	147	18.3
Raptor + Bucril	0.04+0.25	2.0	175	19.4
Raptor + Bucril	0.047+0.25	2.0	188	23.0
Raptor + Select	0.032+0.094	2.2	189	20.1
Raptor + Select	0.04+0.094	2.4	185	17.5
Raptor + Select	0.047+0.094	1.9	183	20.3
Pursuit	0.047	2.5	172	19.9
Pursuit	0.063	2.2	173	23.2
Pursuit + Select	0.063+0.094	2.4	173	20.5
Weedy check		3.5	138	14.2
LSD 0.05		0.3	11	1.4

^aTreatments applied with COC and 32-0-0 at 0.5% and 1.0% v/v.

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