

Evaluation of Raptor 1AS and other Herbicides for Sowthistle, Canarygrass and Wild Oat Control in Alfalfa

Michael D. Rethwisch and John E. Nelson

Abstract

Two rates of Raptor herbicide were evaluated for late winter weed control in alfalfa in combination with various types of surfactants, the insecticide Furadan, and other alfalfa herbicides with known limited control spectrums. Herbicides that were combined with Raptor were also evaluated separately, as was Pursuit. Effects of treatments on wild oats, littleseed canarygrass and annual sowthistle were obtained. Treatments containing the active ingredient clethodim (Select/Prism) reduced canarygrass height and reproduction, while Raptor treatments increased numbers of inflorescences. No treatment provided effective control of sowthistle although some activity was noted from the Raptor treatments when numbers of reproductive structures and height were examined. Surfactants/adjuvants greatly increased Raptor activity. Wild oat control was noted in treatments containing clethodim and several Raptor treatments when utilizing a surfactant/adjuvant.

Introduction

Raptor herbicide's active ingredient (imazamox) is in the same herbicide class (Imidazolinone) as Pursuit herbicide (active ingredient = imazethapyr). Raptor herbicide has the potential for usage in alfalfa, and Pursuit is already registered and used on alfalfa. Although Raptor herbicide has a registration in soybeans, the weeds encountered in late winter and early spring production of desert alfalfa are different than those weeds normally considered problems in soybean production. Raptor also has a slightly different spectrum in efficacy and fewer plant back restrictions than does Pursuit, and therefore has a different usage potential than Pursuit.

This study was conducted primarily to acquire data about the efficacy of Raptor herbicide on alfalfa weeds present in late winter when used at two different rates with representatives of various adjuvant classes. Other herbicides were used by themselves and/or in combination with Raptor; the insecticide Furadan (carbofuran) was also applied with Raptor to determine what effects, if any, this insecticide would have on Raptor performance.

Methods and Materials

Twentyseven herbicide treatments replicated four times in a randomized complete block design were applied the afternoon of March 3, 2000 to an alfalfa field with a sparse stand that had more weeds than alfalfa. The treated area had been mown about 10 days prior to treatment. Weeds were present and abundant. Species present were primarily annual sowthistle (*Sonchus oleraceus* L.) and littleseed canarygrass (*Phalaris minor* Retz.), although wild oats (*Avena fatua* L.) and annual bluegrass (*Poa annua* L.) were also present but less prevalent. Sowthistle rosettes were approximately 5 inches in diameter with some beginning to flower, and grass regrowth was about 6 inches tall at time of application.

The treated area was probably somewhat nutrient deficient and was not irrigated until 24 days post treatment, although a heavy irrigation was applied about a week prior to herbicide application. The experiment also had a soil gradation across plots with Imperial clay and higher levels of salt at one end which lessened to the south across the replicates. Weed composition was affected by this gradation as fewer and shorter sowthistles were noted in the replication with the highest clay and salt content, but increased in number across the experimental plots as clay and salt declined. The opposite was true for littleseed canarygrass which had highest populations in heavier soils where there were fewer sowthistles, and decreased across the experiment as soils gradually lightened.

Each plots was 6 feet wide by 35 feet long, and all plots were situated side by side (entire treated area was 35 x 672 ft) to ensure that streaks of weed species noted in field were equally present in all plots.

Two rates of Raptor™ 1AS were used (4 oz and 5 oz of product per acre) with representatives of various classes of adjuvants. These classes included crop oil concentrate (Cote; Dune Company), esterified seed oil (Hasten; Wilbur Ellis Co.), methylated vegetable oil/silicone spreader (DyneAmic; Helena Chemical Co.), petroleum oil (Mor-Act; Wilbur-Ellis Co.) and a non-ionic surfactant (R-11; Wilbur Ellis Co.). DyneAmic is also noted to be a non-ionic spray adjuvant. Custom Blend, which contains 2% humic acid (WestBridge Corp.), was also added to both rates of Raptor.

Most of the Raptor treatments also included 1 qt/acre of ammonium nitrate (20-0-0) although 20-0-0 was not used Raptor when combined with MorAct, one Custom Blend treatment, when Quest (Helena Chemical Co.), a water conditioning agent for herbicide sprays which also contains ammoniacal nitrogen was added to DyneAmic, and when the fertilizer Musol X-16 (FLIM-USA) was used. The usage of Musol X-16 may interfere with herbicide activity as the Musol X-16 label notes not to use this product with herbicides.

Herbicide active ingredients compared with and also used with Raptor included 2,4-DB (Butoxone 200) which has activity only on broadleaf weeds and clethodim (Prism, Select) which has only grass activity. Both of these herbicides were also used by themselves. Pursuit was also used by itself and in combination with fertier (20-0-0), a surfactant (Cote) and 2,4-DB. Zorial 5G treatments were also applied as an approaching weather front was predicted to provide enough moisture to activate the chemical formulation. The weather system only provided 0.05 inches of moisture on March 5 at the plot site however, far below the 1.0 inches of moisture necessary for chemical activation (this weather system did provide over 1.5 inches of rain in central AZ however).

Treatments were applied with a backpack CO₂ sprayer calibrated to deliver 20 gpa at 30 psi using a six ft wide boom with four T-Jet 8002VS nozzles. Water was buffered with Tri-Fol (Wilbur-Ellis Co.) at the rate of 0.5% volume/volume.

Canarygrass data were collected March 24 (21 days post treatment), April 18-19 (46-47 days post treatment, and May 8 (66 days post treatment). Data were collected by placing a 1/4 meter (50 cm x 50 cm) square in each plot and counting numbers of developing inflorescences on March 24 and April 18-19 within the square. Weed heights were also obtained on March 24 and April 18-19 by measuring 10 plants/plot to the nearest cm. On May 8 numbers of inflorescences per stem were obtained by cutting off 18-20 stems at ground level and counting and recording the number of inflorescences (heads) on each stem.

Sowthistle data were collected March 27 (24 days post treatment) and April 25-27 (53-55 days post treatment). Data were collected by placing a 1/4 meter (50 cm x 50 cm) square in each plot and counting numbers of developing inflorescences sowthistle reproductive structures. Reproductive structures that were still button shaped and had not elongated were not counted. Weed heights were obtained by measuring 10 plants/plot to the nearest cm both sampling periods.

Wild oat data were collected on March 31 (28 days post treatment) and May 5 (63 days post treatment) by counting numbers of extended inflorescences in each plot as populations of this weed were much less prevalent than those of sowthistle and canarygrass. Plant height data were not obtained.

Data were statistically analyzed and means separated utilizing Fishers least significant difference (LSD) program on Statgraphics Plus for Windows (Manugistics, Inc.).

RESULTS

WILD OATS INFLORESCENCES

Many of the treatments greatly reduced (>95%) the number of wild oats in this experiment when compared with the untreated check. The Select treatment resulted in 100% control of wild oats for both sample dates, while Raptor + Select at a reduced rate resulted in 95.9% control at 58 days post treatment, based on using one panicle inflorescence per plant.

Rate responses were noted between the 4 and 5 oz/acre rates of Raptor when used with fertilizers at both 28 and 63 days post treatment. The Raptor 4 oz/acre rate plus fertilizer treatments (20-0-0 and Musol X-16) had little activity and were very similar to the untreated check, but the 5 oz/acre rate reduced numbers by approximately 50-67% for the two sampling dates.

The 5 oz/acre rate of Raptor when used with various surfactants also generally had fewer wild oats than the 4 oz/acre rate of these treatments, although this was not true for R-11 and Hasten treatments. Treatments including Pursuit were also similar to the untreated check at 63 days post treatment. Surfactant type may also affect Raptor activity on wild oats as both rates of Raptor when used with Hasten (an esterified seed oil) had greater than 97.5% control although this was not true at the earlier sampling (28 days post treatment). The Raptor + Hasten treatments were also the only plots in which wild oat inflorescence means decreased between 28 and 63 days post treatment.

SOWTHISTLE HEIGHT

At 24 days post treatments means of sowthistle heights were almost identical in all rates of Raptor (4 oz/acre =14.63 cm; 5 oz/acre =14.62 cm) that included surfactants (Mor-Act, Cote, Hasten, R-11, DyneAmic and DyneAmic + Quest). Sowthistle heights were significantly shorter in all of these treatments compared with the untreated check (39.8 cm). Similar height reductions (63%) were also noted for the Pursuit treatments when compared with the untreated check.

Raptor treatments with fertilizers (20-0-0, Musol X-16) reduced sowthistle heights (approximately 33%) compared with the untreated check although a rate response was noted in this treatment group. Heights for Raptor + Custom Blend treatments were in between the fertilizer and surfactant groups, while Raptor + Furadan was most similar to the surfactant group. The Select, Butoxone and the unactivated Zorial treatments had little effect on sowthistle heights at 24 days post treatment.

At 54 days post treatment height differences were not as evident among treatments, although the three treatments with the tallest sowthistles at 24 days post treatment (Zorial, Select, and the untreated check) were also tallest at 54 days post treatment. Height had increased in these treatments by about 35 cm. Although Raptor treatments had suppressed plant height by 24 days post treatment, plant heights in Raptor treatments increased similarly to and/or greater than the check and Zorial and Select treatments from 24 to 54 days post treatment. This indicates that Raptor, although providing some early height suppression, did not continue to suppress annual sowthistle elongation under the conditions used for this experiment. A rate response was noted for Raptor when used with the various surfactants as the 5 oz/acre rate (50.3 cm) was somewhat shorter than the 4 oz/acre rate (57.6 cm) at 54 days post treatment.

SOWTHISTLE REPRODUCTIVE STRUCTURES

At 24 days post treatment, numbers of sowthistle reproductive structures were very highly correlated ($p < 0.0001$, $r^2 = 0.733$) with sowthistle height, although herbicide treatments also affected floral numbers. The seven treatments with less than 50 floral structures per 1/4 m² were Pursuit + DyneAmic (19.25), Pursuit + Cote (42.25) Raptor 5 oz/acre + Butoxone (34.0), both rates of Raptor + R-11 (35.5 - 4 oz; 27.0 - 5 oz), Raptor 4 oz/acre + Hasten (23.75), and Raptor 4 oz + DyneAmic (45.25). Four of these seven treatments were also among the seven shortest at 24 days post treatment.

Large differences in numbers of floral structures occurred among the Raptor + fertilizer treatments (Musol X-16, 20-0-0) which were almost identical in height, while smaller differences were noted for the Raptor + Custom

Blend treatments where the shorter plants had more floral structures. All herbicide treatments had statistically significantly fewer numbers of such structures than did the untreated check, however, although sowthistle heights in several treatments were very similar to the check.

At 54 days post treatment, plant height was still associated with numbers of reproductive structures but herbicide treatments were also affecting numbers of reproductive structures. A slight rate response was noted for Raptor when used with surfactants as the higher rate had fewer floral structures, although when used with fertilizers the higher rate of Raptor usage resulted in more floral structures. Plants that are stunted in growth sometimes put their energies into increasing the numbers of reproductive structures, which may have occurred in these situations.

No treatment provided acceptable sowthistle control in this experiment, although reductions were noted in reproductive structures indicating activity. Treatments and surfactants which had the most reduction ($\geq 70\%$) in floral structures were Raptor 5 oz + R-11 (79.9%), Raptor 5 oz + Hasten (73.1%), Raptor 5 oz + Mor-Act (72.7%), and Raptor 4 oz + Mor-Act (76.4%).

The clethodim (Select/Prism) and Zorial treatments differed widely in numbers of reproductive structures at 54 days post treatment although both were slightly taller than the untreated check on this sampling date. Select/Prism had the most reproductive structures as this chemistry has no effect on sowthistle and no control was expected. Increased numbers of floral structures is thought to have occurred through increased nutrient availability as this chemistry effectively eliminated canarygrass and wild oats which would be competing for nutrients. Reduced numbers of reproductive structures indicated that Zorial did show some activity, although the lateness of activation for this chemical makes it difficult to compare this treatment to others in the experiment.

CANARYGRASS HEIGHTS

Most treatments, except for the Raptor + fertilizers, Butoxone, Zorial, and Raptor + Custom Blends, reduced canarygrass height by about 33% (10-12 cm) at 21 days post treatment. Raptor + fertilizer treatments had about 10% reduction, while Raptor + Custom Blend treatments reduced plant height by 15%. Little height reduction was noted in the Butoxone or Zorial treatment at 24 days post treatment as Butoxone is not noted for grass weed control, and the Zorial treatment had not been activated.

Treatments that were tallest at 24 days post treatment were also tallest at 46 days post treatment but were also joined at this height level (65+ cm) by all applications of Raptor that had fertilizer (20-0-0, Musol X-16) added without surfactant. All other treatments had height differences of 20-37% (10-20 cm) at 46 DAT compared with the untreated check except for two treatments, both of which contained clethodim (Select/Prism).

The Raptor + clethodim @0.095 lbs active ingredient per acre treatment slowed canarygrass growth as it increased only 14 cm in height from 21 to 46 days post treatment which was only 50% as tall as the untreated check. Height increased by 25-40 cm in almost all other treatments. The 0.25 lbs of active ingredient rate for Select by itself was the only treatment in this experiment which controlled canarygrass, and finding canarygrass in these plots was difficult as most plants had died. The few canarygrass plants still alive averaged only 5.2 cm in height, a reduction of 15 cm from the previous sampling date. The treatments which had the greatest effect on height reduction after Select/Prism treatments were the Raptor treatments when Hasten and R-11 were added.

Plant heights were almost identical in the two Raptor rates when surfactants were added at both sampling dates. Pursuit treatments were also very similar in height to the Raptor plus surfactant treatments at 24 days post treatment, but were about 4 cm taller at 46 days post treatment.

CANARYGRASS INFLORESCENCE NUMBERS

At 24 days post treatment several treatments had delayed/inhibited the formation of heads including both treatments that included the active ingredient clethodim, and several Raptor treatments that included surfactants. Most of the Raptor + surfactant treatments had fewer than 10 heads/ sampling area (1/4m²), with the exception of the 4 oz/acre rate when applied with the cotton seed oil Cote (13.4). Both Pursuit treatments that included Cote averaged less than 10 heads/sampling area, but numbers were higher when Pursuit was used with DyneAmic.

Raptor + fertilizer treatment effects were very different as the Musol X-16 was very similar to the untreated check, while the 20-0-0 had 50% fewer heads than the Musol X-16. Raptor + Custom Blend treatments also differed with the Raptor + Custom Blend + 20-0-0 (33.0 heads) being very similar to the Raptor + 20-0-0 (33.9 heads) while the Raptor + Custom Blend without 20-0-0 treatment mean (56.0) was very similar to Raptor + Musol X-16 means. Highest numbers of heads were noted in the Butoxone treatment.

At 46 days post treatment most treatments had higher numbers of heads than did the untreated check (130.5). The best two treatments were the 0.25 lb active ingredient/acre of clethodim followed by the Raptor + clethodim treatment. Zorial was the only other treatment with less than 100 heads/sampling area. Very high numbers (>200 sampling area) were noted in a number of Raptor + surfactant treatments. Many of these treatments were among the shortest in height at this sampling date, indicating that plant energies may have been directed towards reproduction (stooling, etc.) rather than stem elongation.

NUMBERS OF CANARYGRASS INFLORESCENCES PER STEM

Treatments affected number of inflorescences. The Select treatment (0.25 lbs ai/acre rate) had none, while all other treatments averaged over 1/stem with a few treatments averaging over 2 heads/stem. Of the treatment groupings Raptor (both rates) + surfactants, Pursuit, Raptor + Furadan, and Raptor + Select had significantly fewer heads/stem than the Raptor (both rates) + fertilizers, untreated check, and Butoxone treatments ($p < 0.05$ level, Fishers LSD test).

As the treatments that had high numbers of head/sample area had lower numbers of heads per stem and shorter plant heights, the increased numbers of stems/sample area may be due to stem numbers increasing (stooling) due to herbicide treatment stimulation. Numbers of stems/sample areas were not obtained in this experiment to verify or nullify this potential explanation however, nor were plant numbers.

ACKNOWLEDGEMENTS

The authors thank Jose Solorio, Jeff Primicias and Royce Wehe for assistance with sowthistle data collection during April. Appreciation is also expressed to the following individuals/ companies for supplying products for this experiment: American Cyanamid; Dune Company; Helena Chemical; Norvartis Crop Protection, Inc.; Wilbur-Ellis Co.; Rogellio Perez/FLIM-USA; Valent U.S.A. Corporation; and Westbridge Corporation.