

The Use of Norflurazon (Zorial 5G) in Parker Valley Alfalfa For Purple Nutsedge Suppression in 1998-99

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Abstract

An experiment was conducted in 1998-99 to study the efficacy of spring (April 30, 1998 and March 4, 1999) applications of Zorial 5G (1, 1.5, 2, 2.5, and 3 lb a.i./A), Treflan TR10 (2 lb a.i./A), and Visor 2.5G (0.25 and 0.5 lb a.i./A) on purple nutsedge control in alfalfa. The second half of split Zorial 5G (1+1, 1.5+1.5, and 2+1 lb a.i./A per year) and Treflan TR10 (2+2 lb a.i./A per year) treatments were made each summer (September 8 and June 22). Purple nutsedge suppression on May 27, 1998 increased linearly as the rate of Zorial 5G applied increased from 1.5 to 3 lb a.i./A. The degree of nutsedge suppression resulting from the initial spring Zorial 5G applications increased with time, reached a maximum on August 4, 1998 (52 to 72%), and declined later in the fall. Split spring and summer applications of Zorial 5G at annual rates of 2 or 3 lb a.i./A provided good (80-88%) purple nutsedge suppression in the fall of the first year of this study although the single spring applications of 2 or 3 lb a.i./A provided greater suppression in the spring and early summer. Similar to 1998, there was a slow increase in Zorial 5G efficacy on purple nutsedge during the spring of 1999 with the single spring 1.5 to 3 lb a.i./A Zorial 5G applications resulting in very good control (89-96%) on June 22, 1999. The annual application rate of 1 lb a.i./A Zorial 5G resulted in only fair purple nutsedge control (at best 75%) and was significantly worse than the other Zorial treatments. During June, July and August of 1999, there were no significant differences between treatments that received 1.5, 2, 2.5 or 3 lb a.i./A Zorial in a single spring application. In addition, there were no significant differences in purple nutsedge control between treatments that received greater than 1.5 lb a.i./A in a single spring application versus treatments that received split applications of Zorial 5G. Thus, the split 2 lb a.i./A Zorial 5G treatment and the two split 3 lb a.i./A treatments were not significantly better than the single spring applications of 2 and 3 lb a.i./A, respectively, during the second year of this study. To date, single applications of Visor 2.5G at 0.25 and 0.5 lb a.i./A and the split Treflan TR10 treatment (2+2 lb a.i./A per year) have provided poor purple nutsedge suppression in 1998 (0-25%) and 1999 (0-5%).

Introduction

Purple nutsedge is difficult to control in established alfalfa stands. Zorial 5G is a granular formulation of the preemergence herbicide norflurazon that Novartis Crop Protection, Inc. recently labeled for use in alfalfa to control of many annual broadleaves and grasses and for the suppression of nutsedges. Norflurazon is absorbed by soil colloids, is not subject to leaching and has an average half-life of 45 to 180 days in soil which provides weed control for 6 to 12 months at rates used

in alfalfa. Susceptible weed seedlings must absorb norflurazon through the roots and then translocate the herbicide to shoots. Norflurazon inhibits the biosynthesis of carotenoid pigments which protect chlorophyll from photo-degradation. Thus in the presence of norflurazon, weed seedlings emerge with chlorotic leaves that turn white in sunlight due to the loss of chlorophyll. Susceptible weed seedlings die following the destruction of leaf tissue and exhaustion of food reserves. The current Zorial label restricts annual use rates to 2 lb active ingredient (a.i.) per acre (A) per year. Norflurazon may be applied to healthy stands of established alfalfa no earlier than five months following emergence and, because of its long soil residual, treated acreage may only be rotated to cotton, soybeans, peanuts, or asparagus for 16 months following the last application of Zorial 5G. Special rotational instructions on the label state that in Arizona and California rotational crops may be planted when no signs of phytotoxicity (bleaching or pigment loss in veins) are observed for 4 months following the emergence of bioassay crop plantings.

Knowles et. al. (1997, 1998) conducted field experiments to determine the optimum use and effectiveness of norflurazon for purple nutsedge (*Cyperus rotundus*) control in established alfalfa. Good nutsedge control (80-95%) was obtained in established alfalfa following a two year program during 1996-97 that involved split spring and summer applications of Zorial 5G made immediately after hay harvest and bale removal but prior to an irrigation. Annual Zorial 5G application rates of 1.5 to 2.0 lb a.i./A provided good nutsedge suppression under light to moderate infestations (30 to 50% cover). However, dense nutsedge infestations (65 to 100% cover) required annual Zorial 5G application rates of 3.0 to 4.0 lb a.i./A for 90% or better purple nutsedge control. Zorial Rapid 80 provided poor purple nutsedge control in established alfalfa because it was difficult to get the liquid spray past the foliage of dense stands of nutsedge and onto the soil where irrigation could incorporate and activate the herbicide. The research reported here was conducted to determine the optimum use of norflurazon in newly planted alfalfa fields with light or low density infestations of purple nutsedge.

Materials and Methods

The experiment was initiated on April 30, 1998 to examine the optimum use of norflurazon (Zorial 5G), thiazopyr (Visor 2.5G), and trifluralin (Treflan TR10) for weed control in a new stand of alfalfa. The treatments are listed in Table 1 (1998) and Table 2 (1999) and included single applications of Zorial 5G and Visor 2.5G, split applications of Zorial 5G and Treflan TR10, and an untreated control. The field was prepared and grower collected seed from 'CUF 101' alfalfa was planted on October 29, 1997 in a sandy loam soil similar to that described by Knowles et al. (1998). The initial herbicide treatments were applied on April 30, 1998 following hay harvest (i.e., cutting and hay removal) and were incorporated by flood irrigation on May 5, 1998. All of the granule herbicides were applied using a ground driven Valmar granule applicator (model 1255 PT). Individual plots were 32 feet wide by 300 feet long and were arranged in a randomized complete block design with three blocks. There were no emerged purple nutsedge shoots or summer annual grasses present at the time of the initial applications. The second half of the split application treatments were applied on September 8, 1998. In 1999, the spring herbicide treatments were re-applied on March 4, 1999 and the summer split applications were re-applied on June 22, 1999. In general, the granule herbicides were incorporated within 2 to 4 days of application by flood irrigation. Visual estimates of percent weed control compared to the untreated plots were made following hay harvest at various times as indicated in the data tables. Data were statistically analyzed using ANOVA and, when appropriate, the least significant difference Duncan's Multiple Range Test at the 0.05 probability level.

Results and Discussion

Zorial 5G (1, 1.5, 2, 2.5, and 3 lb a.i./A), Treflan TR10 (2 lb a.i./A), and Visor 2.5G (0.25 and 0.5 lb a.i./A) were first applied on April 30, 1998 about 22 weeks after planting before purple nutsedge and summer annual grasses emerged. As of August 4, 1998, purple nutsedge was the predominate weed in this experiment. Purple nutsedge distribution in the plots was highly variable with many plots in the second block having fairly dense infestations as shown by the percent ground cover data (Table 1). Purple nutsedge suppression was estimated based on the degree of chlorosis, and amount of bleached leaves and necrotic plants in 1998. Little thinning or reduction of purple nutsedge populations was observed until 1999 and then this parameter was also used in evaluating nutsedge suppression. Purple nutsedge suppression on May 27, 1998 increased linearly as the rate of Zorial 5G applied increased from 1.5 to 3.0 lb a.i./A (Table 1). The degree of nutsedge suppression resulting from the initial spring Zorial 5G applications increased with time, reached a maximum on August 4, 1998 and declined later in the fall (Table 1). The slow increase in efficacy was probably due to increased herbicide soil

incorporation and plant uptake caused by the cumulative increase in the amount of applied irrigation water. Zorial rates of 1.5 to 3.0 a.i./A provided moderate purple nutsedge suppression (57 to 72%) on August 4, 1999 (Table 1).

Purple nutsedge was still the predominant weed in the study when the second half of the split Zorial 5G and Treflan TR10 treatments were applied on September 8, 1998. Single spring applications of Zorial 5G at rates ranging from 1 to 3 lb a.i./A still provided moderate (42-68%) purple nutsedge suppression on October 8, 1998 (Table 1). A previous experiment found that superior nutsedge control required a second of application of Zorial 5G during the summer (Knowles et al., 1997). Similarly, split spring and summer applications of Zorial 5G at annual rates of 2 or 3 lb a.i./A provided good (80-88%) purple nutsedge suppression in the fall of the first year of this study (Table 1). On October 8, 1998, the split 2 lb a.i./A Zorial treatment and the two split 3 lb a.i./A Zorial treatments resulted in greater purple nutsedge suppression in the fall than the 2 lb a.i./A and 3 lb a.i./A single spring application treatments, respectively, although the latter treatments provided greater suppression in the spring and summer (Table 1). The two annual split 3 lb a.i./A Zorial 5G treatments did not result in significantly better purple nutsedge control than the split 2.0 lb a.i./A Zorial 5G treatment on October 8, 1998 (Table 1).

In 1998, single applications of Visor 2.5G at 0.25 and 0.5 lb a.i./A and a 4 lb a.i./A split application of Treflan TR10 provided poor (17 to 33%, at best) purple nutsedge control (Table 1). The Visor treatments caused purple nutsedge plants to become slightly chlorotic and to produce slightly narrower leaves than normal but the effects were short lived. The Visor and Treflan treatments were applied primarily to determine their effects on summer annual grass weeds (e.g., sprangletop, junglerice, and barnyardgrass) but grass emergence was minimal, so the efficacy of the herbicides on grasses was not evaluated. The 0.25 lb a.i./A Visor treatment was eliminated in 1999.

In the spring 1999, the Zorial 5G (1, 1.5, 2, 2.5, and 3 lb a.i./A), Treflan TR10 (2 lb a.i./A), and Visor 2.5G (0.5 lb a.i./A) treatments were reapplied to one year, 5 month old 'CUF 101' alfalfa on March 4, 1999 before significant amounts of purple nutsedge emerged. The second half of the split applications were reapplied on June 22, 1999. During the summer of 1999, purple nutsedge was still the predominate weed in this test. Similar to 1998, there was a slow increase in Zorial 5G efficacy on purple nutsedge during the spring of 1999 with the single spring 1.5 to 3 lb a.i./A Zorial 5G applications resulting in very good control (89-96%) of this weed on June 22, 1999 (Table 2). The annual application rate of 1 lb a.i./A Zorial 5G resulted in only fair purple nutsedge control (at best 75%) and was significantly worse than the other Zorial treatments (Table 2). The Treflan TR10 and Visor 2.5G treatments resulted in poor control (0-5%) of purple nutsedge similar to the results obtained in 1998. Interestingly, during June, July and August of 1999, there were no significant differences between treatments that received 1.5, 2, 2.5 or 3 lb a.i./A of Zorial 5G in a single spring application (Table 2). In addition, there were no significant differences in purple nutsedge control between treatments that received 1.5 lb a.i./A of Zorial 5G or more in a single spring application versus treatments that received split applications of Zorial 5G (Table 2). Thus, the split 2 lb a.i./A Zorial 5G treatment and the two split 3 lb a.i./A Zorial 5G treatments were not significantly different than the single spring applications of 2 and 3 lb a.i./A, respectively, during the second year of this study (Table 2). On two occasions, once in early summer of each year of the study, a few alfalfa plants with white leaves were observed in a plot that received single spring application of 3 lb a.i./A of Zorial 5G.

In conclusion, this study provided new information regarding the use of Zorial 5G in newly planted alfalfa fields. In such fields, there does not appear to be any benefit in applying more than 1.5 to 2 lb a.i./A of Zorial if a Zorial 5G treatment program is initiated in the spring following a fall planting. This is in contrast to the conclusion of Knowles et al. (1997) that 3 or more lb a.i./A per year were needed to provide adequate purple nutsedge control in heavily infested fields when a Zorial treatment program was not started until the second or third year of the alfalfa stand. However, similar to previous results (Knowles et al., 1997), two or more years of Zorial treatments were required to provide adequate purple nutsedge control and to substantially reduce nutsedge population densities. In the study reported here, there was no difference in purple nutsedge control between split application (spring and summer) treatments versus single spring application treatments in the second year of the alfalfa stand when the same amount of Zorial 5G was applied annually. However, during the first year, a summer application of Zorial did substantially increase the degree of purple nutsedge suppression observed in the fall.

The results of recent studies on purple nutsedge control in alfalfa indicate that alfalfa fields badly infested with purple nutsedge and that will be replanted with alfalfa can be treated with the following cultural regime to minimize the impact of this perennial weed. Following that last late summer hay harvest, irrigate the field to avoid water stressed alfalfa and purple nutsedge. About a week after irrigation, spray the field with Roundup Ultra at 3 lb a.i./A (equivalent to 2.25 lb a.e./A or 3 quarts/A). Use a spray grade of ammonium sulfate at a rate of 8.5 to 17 lb/100 gal to counteract the effects of poor water

quality on Roundup. After allowing the herbicide to function for a couple of weeks, begin normal field preparations for replanting alfalfa (e.g., leveling and discing). Fields that do not have heavy purple nutsedge infestations may not need to be sprayed with Roundup especially if land preparation and discing bring purple nutsedge tubers to the soil surface where they will desiccate and die. Taking advantage of the fact that purple nutsedge grows best in hot moist conditions, plant the alfalfa field in the fall so that the alfalfa can get established during cooler conditions without much competition from purple nutsedge. The current Zorial 5G label specifies that no more than 20 lbs of Zorial 5G (1 lb a.i./A of norflurazon) can be applied in the spring in alfalfa fields planted the previous fall. Thus, 1 lb a.i./A of Zorial 5G should be applied in the spring following the first hay harvest and a second application of 1 lb a.i./A of Zorial 5G should be applied in early summer. In subsequent years, Zorial 5G can be applied in a single spring application of 2 lb a.i./A or in split applications of 1 plus 1 lb a.i./A or 1.5 plus 0.5 lb a.i./A. In fields with light to moderate purple nutsedge infestations and coarse textured soil (e.g., sandy loams to loams), this study indicates that annual application rates of 1.5 lb a.i./A for several years may provide adequate purple nutsedge control. In addition, single spring applications in the second and subsequent years of the alfalfa stand will reduce application costs. In fields heavily infested with purple nutsedge or in soils with substantial clay content, the annual application rate of Zorial 5G should be 2 lb a.i./A. In view of the long soil residual of Zorial and the rotational restrictions on the Zorial label, established alfalfa fields should probably not be treated during the last year of the stand in order to reduce the risk of injury to rotational crops.

References/Previous Research

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Table 1. Purple nutsedge weed control and ground cover in 1998 in a Parker Valley alfalfa field. The first applications of norflurazon (Zorial 5G), thiazopyr (Visor 5G), and trifluralin (Treflan TR10) were made on April 30th and the second half of the split treatments were applied on September 8, 1998.

| Treatment | Rate | Nutsedge Cover ¹ | | Purple Nutsedge Control ² | | | |
|--------------|--------------------|-----------------------------|------------|--------------------------------------|------------|------------|------------|
| | | 9-8-98 | 5-27-98 | 7-6-98 | 8-4-98 | 9-8-98 | 10-8-98 |
| | <i>(lb a.i./A)</i> | <i>(% plot)</i> | <i>(%)</i> | <i>(%)</i> | <i>(%)</i> | <i>(%)</i> | <i>(%)</i> |
| Untreated | - | 10, 90, 40 | 0 g | 0 f | 0 g | 0 d | 0 f |
| Zorial 5G | 1 | 10, 5, 7 | 20 de | 28 cde | 52 cd | 35 c | 42 e |
| Zorial 5G | 1.5 | 10, 25, 3 | 23 de | 32 cd | 57 bcd | 38 bc | 45 de |
| Zorial 5G | 2 | 5, 8, 4 | 32 bc | 42 ab | 65 ab | 55 a | 60 cd |
| Zorial 5G | 2.5 | 50, 10, 10 | 32 b | 42 ab | 72 a | 52 a | 68 bc |
| Zorial 5G | 3 | 5, 65, 2 | 46 a | 50 a | 68 ab | 55 a | 55 cde |
| Zorial 5G | 1 + 1 | 10, 80, 5 | 25 cde | 28 cde | 48 d | 32 c | 80 ab |
| Zorial 5G | 1.5 + 1.5 | 8, 10, 5 | 27 bcd | 35 bc | 63 abc | 48 ab | 82 ab |
| Zorial 5G | 2 + 1 | 5, 3, 20 | 25 cde | 32 cd | 68 ab | 40 bc | 88 a |
| Visor 2.5G | 0.25 | 20, 75, 10 | 12 f | 20 e | 23 ef | 0 d | 0 f |
| Visor 2.5G | 0.5 | 10, 75, 10 | 18 ef | 25 de | 33 e | 7 d | 0 f |
| Treflan TR10 | 2 + 2 | 35, 90, 10 | 12 f | 20 e | 17 f | 3 d | 0 f |

¹Purple nutsedge percent ground cover listed in replication order (i.e., rep. 1, rep. 2, and rep. 3).

²Data are means of 3 replications; means within columns followed by the same letter are not significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

Table 2. Purple nutsedge weed control in 1999 in a Parker Valley alfalfa field. Applications of norflurazon (Zorial 5G), thiazopyr (Visor 5G), and trifluralin (Treflan TR10) were made on March 4th and the second half of the split treatments were applied on June 22, 1999.

| Treatment | Rate (lb a.i./A) | Purple Nutsedge Control ¹ | | | | |
|--------------|---------------------|--------------------------------------|----------------|----------------|----------------|----------------|
| | | 4-15-99 (%) | 5-20-99 (%) | 6-22-99 (%) | 7-21-99 (%) | 8-30-99 (%) |
| Untreated | - | 0 d | 0 e | 0 c | 0 d | 0 d |
| Zorial 5G | 1 | 47 c | 57 c | 75 b | 70 c | 63 c |
| Zorial 5G | 1.5 | 58 b | 68 b | 89 a | 85 ab | 80 b |
| Zorial 5G | 2 | 62 ab | 68 b | 92 a | 87 ab | 83 b |
| Zorial 5G | 2.5 | 60 cb | 73 ab | 90 a | 83 b | 82 b |
| Zorial 5G | 3 | 68 ab | 78 a | 96 a | 88 ab | 89 ab |
| Zorial 5G | 1 + 1 | 47 c | 58 c | 88 a | 83 b | 83 b |
| Zorial 5G | 1.5 + 1.5 | 70 a | 70 b | 96 a | 93 a | 97 a |
| Zorial 5G | 2 + 1 | 65 ab | 73 ab | 89 a | 90 ab | 96 a |
| Visor 2.5G | 0.5 | 0 d | 13 d | 5 c | 5 d | 0 d |
| Treflan TR10 | 2 + 2 | 0 d | 0 e | 3 c | 0 d | 0 d |

¹Data are means of 3 replications; means within columns followed by the same letter are not significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.