

Nutsedge Control In Cotton Using Norflurazon (Zorial Rapid 80): A Progress Report

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Abstract

Field experiments were conducted in 1992 and 1993 to determine the crop safety and efficacy of norflurazon applications for control of purple and yellow nutsedge in cotton. Norflurazon was applied preplant-incorporated (PPI) or in two applications, PPI and postemergence (POST) when cotton was 3 to 4" tall. As the PPI norflurazon application rate increased from 0.5 to 0.75, 1.0, and 1.25 lb a.i./A, early season nutsedge control increased from 29 to 49, 58, and 76% of control. Early season weed control declined after about 6 weeks. POST emergence applications of norflurazon prolonged the period of nutsedge control. Data collected 71 and 21 days after the PPI and POST applications, respectively, showed that the 0.5+1.5, 0.75+1.25, and 1.0+1.0 lb a.i./A (PPI+POST) treatments resulted in 85, 76, and 73% control of nutsedges. Nutsedge control declined throughout the season with the 0.5+1.5, 0.75+1.25, and 1.0+1.0 lb a.i./A split applications all resulting in about 27% control 3 months after the POST applications. PPI rates 1.5 to 2 times the labeled rate for a particular soil type caused cotton injury in several experiments in the 1993 cotton season although no injury was observed in the 1992 season.

Introduction

Nutsedge, particularly purple nutsedge (*Cyperus rotundus*), infestations in cotton are becoming increasingly widespread and severe for several reasons: 1) control of other weeds has provided an open niche for nutsedges, 2) laser leveling of fields has efficiently spread nutsedge tubers within individual fields and between fields, 3) the lack of rotation with other crops more competitive against nutsedges than cotton, and 4) the lack of effective herbicide treatments, particularly herbicides that can be used in cotton preplant-incorporated, for early season suppression and control of nutsedges. Purple and yellow nutsedge have faster growth rates than cotton because they possess physiological mechanisms that result in more efficient use of resources such as water, CO₂, light and heat in the climate characteristic of the low desert cotton production areas in Arizona. Thus, these species are very effective early season competitors with cotton and can reduce cotton yields significantly.

Norflurazon has long been registered for nutsedge control in cotton in the Southeastern U.S. but was not registered for use in Arizona prior to the 1993 cotton season. Arizona cotton production areas are characterized by coarse and medium textured soils typically containing less than 1% organic matter that have low adsorptive capacities for herbicides. Although cotton has some tolerance to norflurazon, preplant-incorporated applications of norflurazon in Arizona soils at rates required to provide good control of nutsedges cause unacceptable injury and stand loss because norflurazon is readily available for uptake from the soil by cotton seedlings. The objectives of the experiments described in this paper were to investigate the crop safety and efficacy of norflurazon (Zorial Rapid 80) for nutsedge control when applied preplant-incorporated or when applied both

preplant-incorporated and postemergence.

Materials and Methods

The 1992 experiments were conducted in fields that were planted to moisture. Norflurazon was either applied broadcast to flat ground, incorporated (1 site) or not incorporated (1 site), the field listed, preirrigated and planted or the herbicide was applied broadcast over the top of the beds after listing and preirrigation, mulched into the beds, and planted (2 sites). In the 1993 experiments, norflurazon was applied broadcast to flat ground and incorporated in fields that were either planted to moisture (2 sites) or were dry planted and irrigated up (2 sites). Treatments typically included a control (no herbicide application) and 0.5, 0.75, 1.0 lb active ingredient (a.i.)/A of norflurazon applied preplant followed by a second postemergence application at 1.5, 1.25, and 1.0 lb a.i./A, respectively, to yield a total application rate of 2 lb/A. Trifluralin (Treflan) or pendimethalin (Prowl) at usual rates were used along with norflurazon in most experiments (trifluralin and pendimethalin have no herbicidal effect on purple and yellow nutsedge.) A randomized complete block design with four blocks (*i.e.*, replications) was used in all experiments. The postemergence applications of norflurazon were made when the cotton was 3 to 4" tall. The spray solution was directed in the area between crop rows and was incorporated with a rolling cultivator or knives and sweeps. Irrigations following the postemergence norflurazon applications resulted in further incorporation and movement of norflurazon into the crop row. Visual weed control ratings were made at various times after planting as indicated below to assess both early season control from the PPI applications and late season control that resulted from the combined PPI and POST applications. Norflurazon inhibits carotenoid pigment synthesis in leaves and the subsequent lack of carotenoids in the presence of light results in the photodegradation of chlorophyll causing affected plants to appear white (Bartels and Watson, 1978). Norflurazon does not stop the emergence of nutsedge shoots since light is required for herbicidal activity. Thus, weed control ratings were based on the presence of white or dead nutsedge leaves and reductions in the number of live nutsedge shoots in the experimental plots. Cotton injury ratings were based primarily on early season stunting and to a smaller extent stand loss when it occurred. Analysis of variance and mean separation were used to elucidate treatment differences.

Results and Discussion

The 1992 Maricopa Agricultural Center (MAC) experiment showed that early season control of yellow nutsedge (% control 27 DAP) resulting from the PPI application increased as the rate of norflurazon applied increased (Table 1). Similar results were obtained at the same site in 1993 (% control 28 DAP; Table 2) and at the Virden, New Mexico site (% control 28 DAT; Table 3). At MAC in 1992, the 0.5 lb/A PPI treatment that was not followed by a POST application resulted in significantly poorer nutsedge control than the other treatments (Table 1). In addition, nutsedge control following the 0.25 and 0.5 PPI applications was significantly improved by the POST applications (Table 1 and 2). These data indicate that the POST applications were necessary to obtain improved control for a longer periods of time. There were no significant differences in the levels of nutsedge control obtained later in the season between the various PPI and POST combinations when the total amount of norflurazon applied was 2 lb a.i./A (Table 1, 3, 4 and 5). The degree of nutsedge control obtained when the PPI applications were sprayed on the flat (early nutsedge control rating; Table 1 and 2) was superior to the control obtained when the PPI applications were sprayed after listing over the top of the beds (early nutsedge control rating; Table 3 and 5). This difference in weed control was probably due to the movement of herbicide treated soil into the furrows when beds were mulched following over the top applications and due to the shallower depth of herbicide treated soil in the beds in the seed row. Comparison of early season and late season nutsedge control shows that control declines significantly as the season progresses (Table 3, 4 and 5). Since late season nutsedge control is relatively poor, particularly if only a PPI application is made, several years of norflurazon use combined with other herbicides with activity on nutsedges (*e.g.*, MSMA) and with a competitive cotton crop would probably be required to lower nutsedge population densities. It should also be noted that the soil persistence of norflurazon restricts crop rotation options.

The safety of norflurazon to cotton was assessed in all experiments conducted in 1992 and 1993. No crop injury symptoms were noted in any of the 1992 experiments (Table 1, 3, 4 and 5), however, substantial injury occurred in the experiment conducted at MAC in 1993 (Table 2). The reason for this difference is not clear although the PPI application was shallowly incorporated using a rototiller in 1992 whereas a four row S-tine implement was used for incorporation at MAC in 1993. The latter implement may have resulted in nonuniform and deeper incorporation than the rototiller and this in turn may have resulted in significantly more herbicide treated soil below the depth at which the cotton seeds were planted. There were also differences in weather patterns between years with 1993 being characterized by a wetter winter and warm windy conditions following planting at MAC. The cotton seedlings may have been stressed more in 1993 than 1992 increasing their susceptibility to herbicide injury. Another experiment conducted in 1993 east of MAC on a clay loam where norflurazon was applied PPI on the flat and the cotton dry planted and then irrigated every other row, also tended to show some minor stunting and stand loss although the injury was not statistically different from the controls due to random variation and was not visible later in the season. In other experiments conducted in 1993 on sands and sandy loams, norflurazon PPI applications on the flat followed by dry planting and irrigation every other row did not show injury symptoms because norflurazon was not concentrated in the seed zone of the beds. Additional field experiments need to be conducted to further characterize the conditions under which cotton is susceptible to norflurazon injury, particularly on coarse textured soils.

References

Bartels, P.G. and C.W. Watson. 1978. Inhibition of carotenoid synthesis by fluridone and norflurazon. *Weed Sci.* 26:198-203.

Table 1. The effect of norflurazon on yellow nutsedge control at the Maricopa Agricultural Center in 1992¹.

Zorial Rate (lb a.i./A)		Nutsedge Control (% of control plots)	
PPI	POST	45 DAT (27 DAP) ²	71 DAT (53 DAP)
0.25	1.75	41	82
0.5	0	45	32
0.5	1.0	52	72
0.5	1.5	51	86
0.75	1.25	78	78
1.0	1.0	94	72

¹ Cotton variety was DPL5415 planted on May 1; soil was a sandy loam (coarse texture); PPI herbicide was applied on the flat and incorporated with a rototiller.

² POST treatments not yet performed; DAT, days after treatment; DAP, days after planting.

Table 2. The effect of norflurazon on yellow nutsedge control at the Maricopa Agricultural Center in 1993¹.

Zorial Rate (lb a.i./A)		Nutsedge Control (% of control plots)	
PPI	POST	43 DAT (28 DAP) ²	43 DAT (28 DAP)
0.5	1.5	29	15
0.75	1.25	45	40
1.0	1.0	58	42
1.25	0.75	76	63

¹ Cotton variety was DPL5415 planted on April 26; soil was a sandy loam (coarse texture; Zorial label rate of 0.5 lb a.i./A); PPI herbicide was applied on the flat and incorporated with a four-row S-tine rig followed by a cultipacker.

² POST treatments not yet performed; DAT, days after treatment; DAP, days after planting.

Table 3. The effect of norflurazon on purple nutsedge control at the Virden, NM site in 1992¹.

Zorial Rate (lb a.i./A)		Nutsedge Control (% of control plots)	
PPI	POST	28 DAT ²	122 DAT
0.5	1.0	29	39
0.5	1.5	30	39
0.75	1.25	46	39
1.0	1.0	50	41
1.25	0.75	61	35

¹ Soil was a clay loam (medium texture; Zorial label rate of 0.75 lb a.i./A); PPI herbicide was applied broadcast over the top of the beds, mulched and planted.

² POST treatments not yet performed; DAT, days after treatment.

Table 4. The effect of norflurazon on purple nutsedge control at the Coolidge site in 1992¹.

Zorial Rate (lb a.i./A)		Nutsedge Control (% of control plots)	
PPI	POST	91 DAT ²	120 DAT
0.5	1.0	50	36
0.5	1.5	70	38
0.75	1.25	80	49
1.0	1.0	82	43

¹ Soil was a sandy loam (coarse texture; Zorial label rate of 0.5 lb a.i./A); herbicide was applied on the flat and was not incorporated prior to listing.

² PPI and POST treatments already performed; DAT, days after treatment.

Table 5. The effect of norflurazon on purple nutsedge control at the Thatcher site in 1992¹.

Zorial Rate (lb a.i./A)		Nutsedge Control (% of control plots)	
PPI	POST	43 DAT ²	156 DAT
0.5	1.5	45	23
0.75	1.25	50	25
1.0	1.0	59	26

¹ Soil was a sandy loam (coarse texture; Zorial label rate of 0.5 lb a.i./A); herbicide was applied on the flat and was not incorporated prior to listing.

² POST treatments not yet performed; DAT, days after treatment.