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Growth Stage Comparison Of Postemergence Herbicides On Three Grass Species

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Abstract

Clethodim (Select®), quizalofop (Assure®), fluazifop-p (Fusilade 2000®), and sethoxydim (Poast Plus®) were studied in 1990 and 1991 to determine the level of control of seedling johnsongrass, barnyardgrass, and southwestern cupgrass when applied at three different growth stages. Experiments were conducted three times for johnsongrass and two times for barnyardgrass and southwestern cupgrass. Treatments were applied at grass heights of 1 to 3, 3 to 6, and 6 to 9 inches. Johnsongrass was controlled 90% or greater with clethodim, quizalofop, and fluazifop applied at all growth stages. In one experiment, sethoxydim gave less than 80% control at all johnsongrass stages. Control of southwestern cupgrass at the 1- to 3-inch and 3- to 6-inch stages was 90% or greater with all herbicides except for quizalofop in one experiment and sethoxydim in another. All herbicides gave less than 70% control at the 6- to 9-inch stage. Barnyardgrass control was greater than 90% with all herbicides and stages in one experiment. In a second experiment, clethodim and quizalofop were the only herbicides resulting in greater than 90% control at the 6- to 9-inch stage.

Introduction

With johnsongrass [*Sorghum halepense* (L.) Pers.] found in the United States for more than 200 years, one would think that its control would have become effortless. In fact, johnsongrass has been listed as Mississippi's first, second, third, and fifth worst weed in cotton (*Gossypium hirsutum* L.), sorghum (*Sorghum bicolor* (L.) Moench], soybean [Glycine max (L.) Merr.], and corn (*Zea mays* L.), respectively (13,15).

Johnsongrass competes with other species by rapidly fixing carbon dioxide as well as producing high quantities of rhizomes and seeds (4). It has been suggested that johnsongrass may release a biological substance that interferes with the growth of other plant species (9). This type of inhibitition, coupled with competition for nutrients, causes a decrease in crop yields as well as seed damage of soybeans and cotton (14, 28). It has been reported that an increased amount of extraneous material and moisture content are found in the harvested seeds of soybeans that are raised in fields heavily infested with johnsongrass (14). Even diseases, such as the maize virus of field corn, are linked to the occurrence of johnsongrass in fields (12).

One of the best ways to control johnsongrass is through use of herbicides either applied alone or in combination (27). They can be distributed by preplant foliar, preplant soil incorporated, preemergence, or postemergence application (2). Some of the more popular herbicides for johnsongrass control include quizalofop, fluazifop , clethodim, and sethoxydim (2). Combinations of postemergence herbicides through tank mixing have been used in controlling johnsongrass, but some combinations may actually reduce efficacy (27). These herbicides are all effective, as well as highly selective, in controlling johnsongrass when applied over-the-top (2). Studies have reported the control of johnsongrass to be anywhere from 75% to 90% using these herbicides (14,28).

However, most selective postemergence herbicides work best in controlling johnsongrass populations when applied repeatedly through the growing season rather than in a single application (27).

Repeated applications, coupled with the site-specific activity of this group of herbicides, have resulted in graminicide-resistant johnsongrass (2). Current recommendations state that applications of these herbicides should be made when seedling johnsongrass is 2 to 10 inches tall depending on the herbicide. Recent reductions in herbicide costs, differences in growth stage recomendations, and the occurrence of resistance, necessitated the need for control data at earlier, more well-defined timings in an effort to obtain consistent control.

Barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] is from Europe and India, but is found in Chinese drawings that date back to 1590 (8, 11). It is found in 47 countries and is a serious weed problem in 22. Barnyardgrass can be found in both temperate and tropical locations (7). In 1991, it infested 1,766,804 acres, or approximately 20% of all land used in the United States for cotton and is found in 36 crops worldwide (18). It is a principal weed of rice and cotton, but it also reduces yields in potatoes (3), corn (6), sugarbeets, melons, green peas (22) , and snap beans (21). Barnyardgrass not only depletes the soil of nitrogen, but is also host to viruses that infect rice and other crops (8).

Barnyardgrass is a growing problem because of its ability to germinate and grow at a wide range of temperatures, with each plant producing anywhere from 9,700 seeds during the month of August to 15,000 seeds between the months of April, May, and June (8, 16). Photoperiods for flowering range from 8 to 16 hours. This photoperiod determines the range of seed dormancy, which can be anywhere from 0 to 48 months. However, there have been reports of seed being viable after 6 to 8 years (8, 16). If it is allowed to grow undisturbed for 6, 9, 12, and 25 weeks in the field, it has been found to decrease cotton yields by 21, 59, 90, and 97%, respectively (10). Competition in rice reduces yields 25% if there is one plant per square foot of rice (26).

Control of barnyardgrass in rice has been with the use of herbicides such as propanil (Stam®), thiobencarb (Bolero®), bifenox (Mowdown®), and fenoxaprop (Whip®). Commonly used postemergence herbicides in cotton are fluazifop, quizalofop-p (Assure II®), sethoxydim, clethodim, and fenoxaprop. One study showed that tank mixing grass herbicides with imazaquin (Scepter®) gave better conrol of barnyardgrass than when applied alone (23, 24, 25). However, sethoxydim and quizalofop resulted in antagonism when tank mixed with any broadleaf herbicide (17). Another study showed fenoxaprop gave 92% control, while sethoxydim and haloxyfop (Verdict) provided marginal control (20).

Eriochloa H.B.K. is a group of grasses that contains about 25 species found in warm and tropic regions of both hemispheres. Seven of these are found in the United States, with four being annual and three being perennial. The annuals are found in marshy areas as well as along roadsides and on ditch banks. Some perennials are used as forage grasses in the Great Plains region (19). Southwestern cupgrass (*Eriochloa gracilis* Fourn.) is a tufted annual grass having one to several stems and standing 85 centimeters tall. It occurs from southern California eastward to southern Virginia and southward to Florida (1, 19). To date, little information is available on the control of this annual species of cupgrass. Data are provided here to fill the information gap on this sparsely populated annual.

The objective of this research was to determine differences in growth-stage response of johnsongrass, barnyardgrass, and southwestern cupgrass to labelled rates of currently available graminicides.

Materials and Methods

Experiments were conducted in 1990 and 1991 at the Delta Branch Experiment Station, Stoneville, MS. Plot size for the experiments was 10 feet by 15 feet and soil type in the test area was a Bosket very fine sandy loam (fine-loamy mixed, thermic Mollic Hapludalf). The experimental design was a factorial arrangement of treatments in a randomized complete block with four replications. There was no fertilization or irrigation applied during the study.

Herbicides were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gallons per acre with a pressure of approximately 25 psi. Clethodim was applied as Select at 12.8 oz/A and quizalofop was applied as Assure at 16 oz/A. Both fluazifop-p (Fusilade 2000) and sethoxydim (Poast Plus) were applied at 24 oz/A. All treatments included crop oil concentrate (Agridex®) at 1% v/v. Treatments, arranged factorially, were applied at three different growth stages: 1 to 3 inches, 3 to 6 inches, and 6 to 9 inches. Plots were visually rated for percent control at 14 days after treatment on a scale of 0 to 100, where 0 equals no control and 100 equals complete kill. Johnsongrass was evaluated in one experiment in 1990 and in both in 1991. Barnyardgrass was evaluated in two experiments in 1991, and southwestern cupgrass was evaluated in two experiments conducted in 1990. Differences in treatments across studies prevented combining data over experiments. Data were analyzed using analysis of variance. Means were separated using Fisher's Protected LSD.

Results and Discussion

Johnsongrass Control

Johnsongrass control with clethodim, quizalofop and fluazifop was 96% or greater for the 1- to 3-inch and 3- to 6-inch stage in both experiments (Figures 1 and 2). Control was 90% or greater for the 6- to 9-inch stage. Sethoxydim resulted in 74%, 43%, and 76% control for the 1- to 3-inch, 3- to 6-inch, and 6- to 9-inch stage, respectively, in 1990 (Figure 1). However, control was 100%, 92%, and 89% for these stages in 1991 (Figure 2). Less rainfall after spraying occurred in 1990 than 1991, and possibly decreased control with sethoxydim. Research shows that low soil moisure conditions decrease the efficacy of sethoxydim (5). There was 100% control for all herbicides applied at each growth stage in a third experiment (data not shown). In the third experiment, applications were made where soil moisture conditions were near field capacity and resulted in excellent control of all stages with all herbicides.

Baryardgrass Control

In 1991, clethodim resulted in 100%, 89%, and 94%

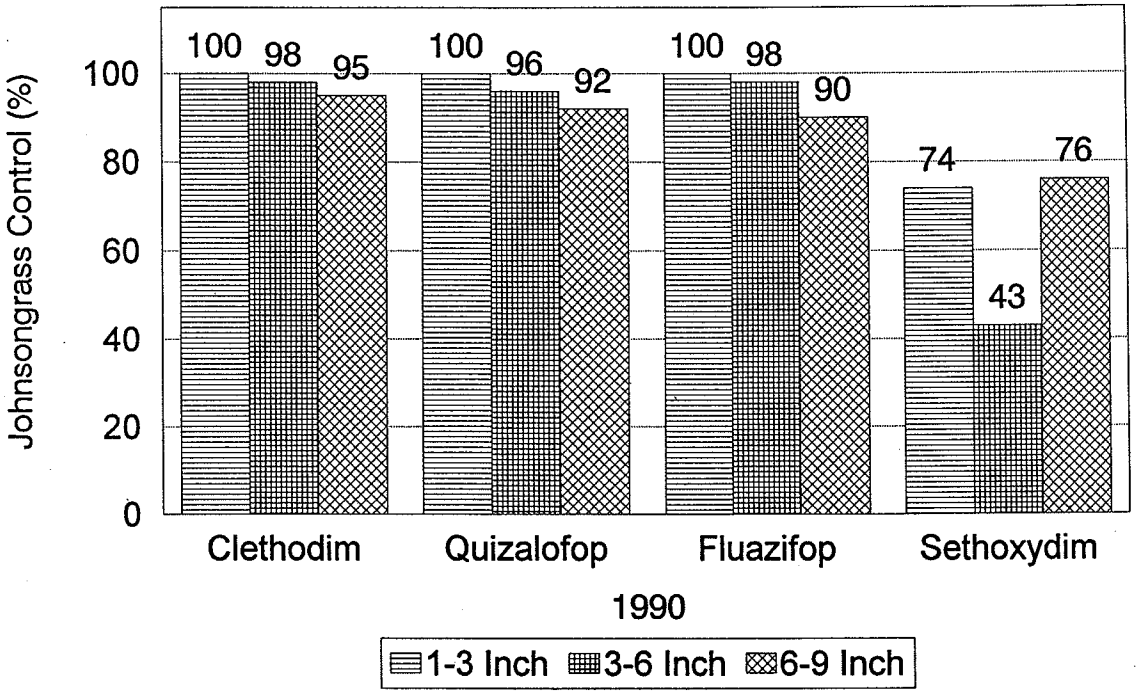

Figure 1. Johnsongrass control at 14 days after treatment (DAT) with various herbicides applied at three weed stages.

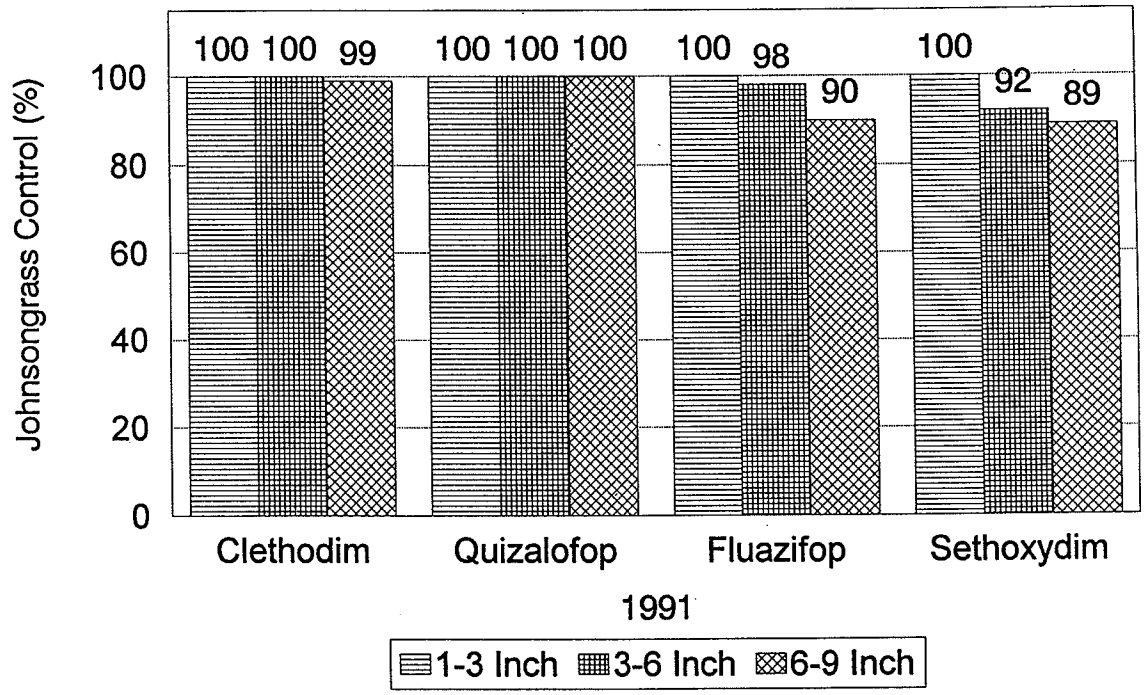

Figure 2. Johnsongrass control at 14 DAT with various herbicides applied at three weed stages.

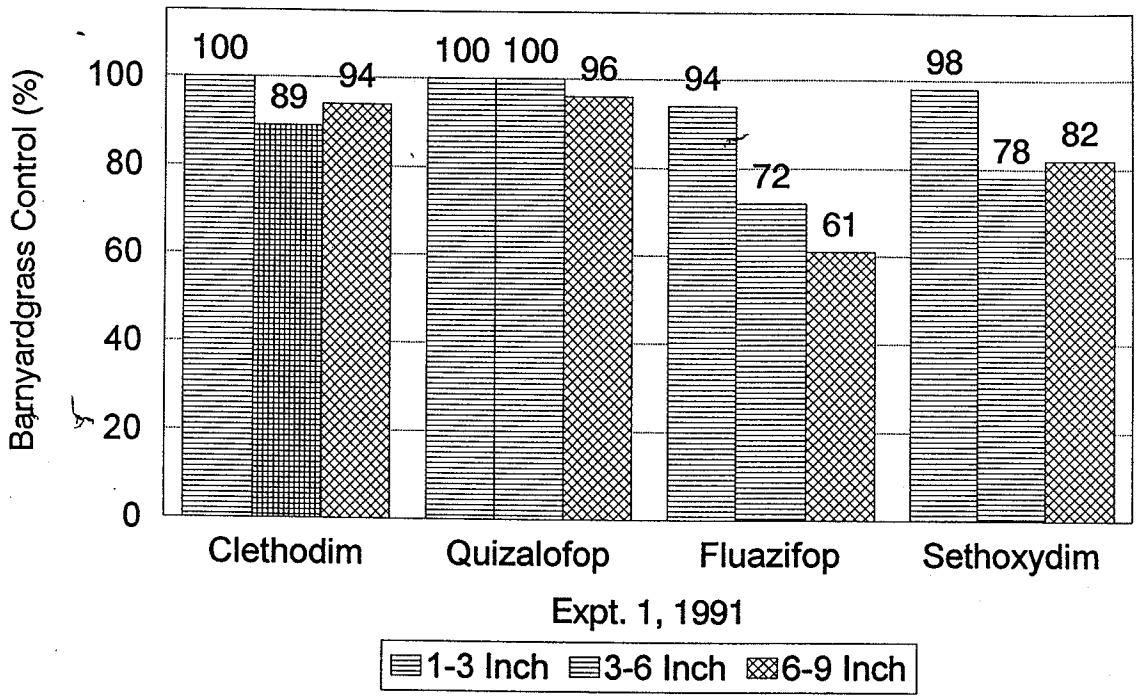

Figure 3. Barnyardgrass control at 14 DAT with various herbicides applied to three weed stages.

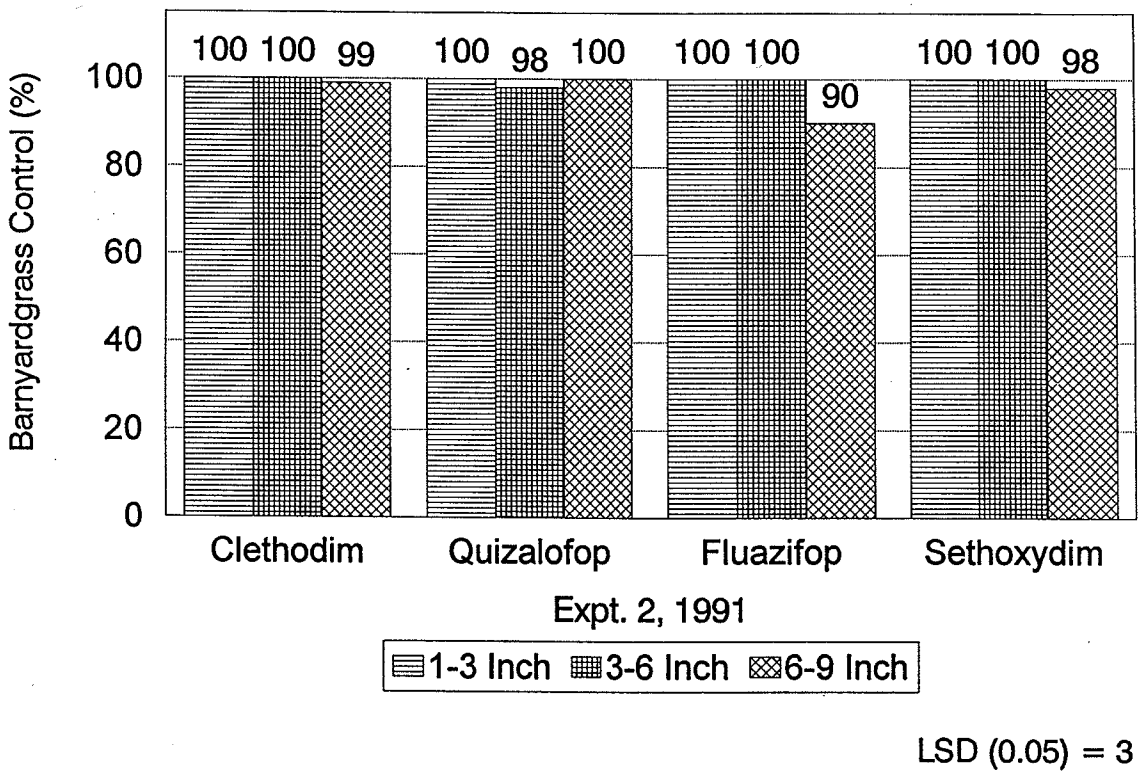

Figure 4. Barnyardgrass control at 14 DAT with various herbicides applied at three weed stages.

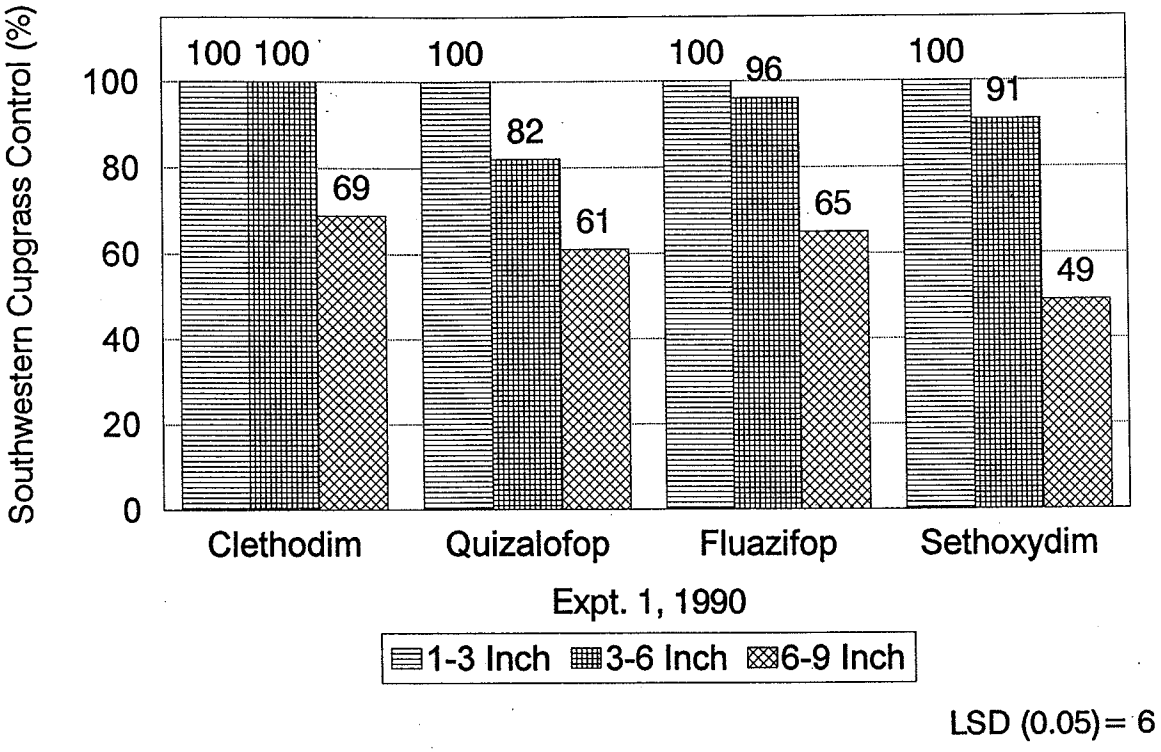

Figure 5. Southwestern cupgrass control at 14 DAT with various herbicides applied at three weed stages.

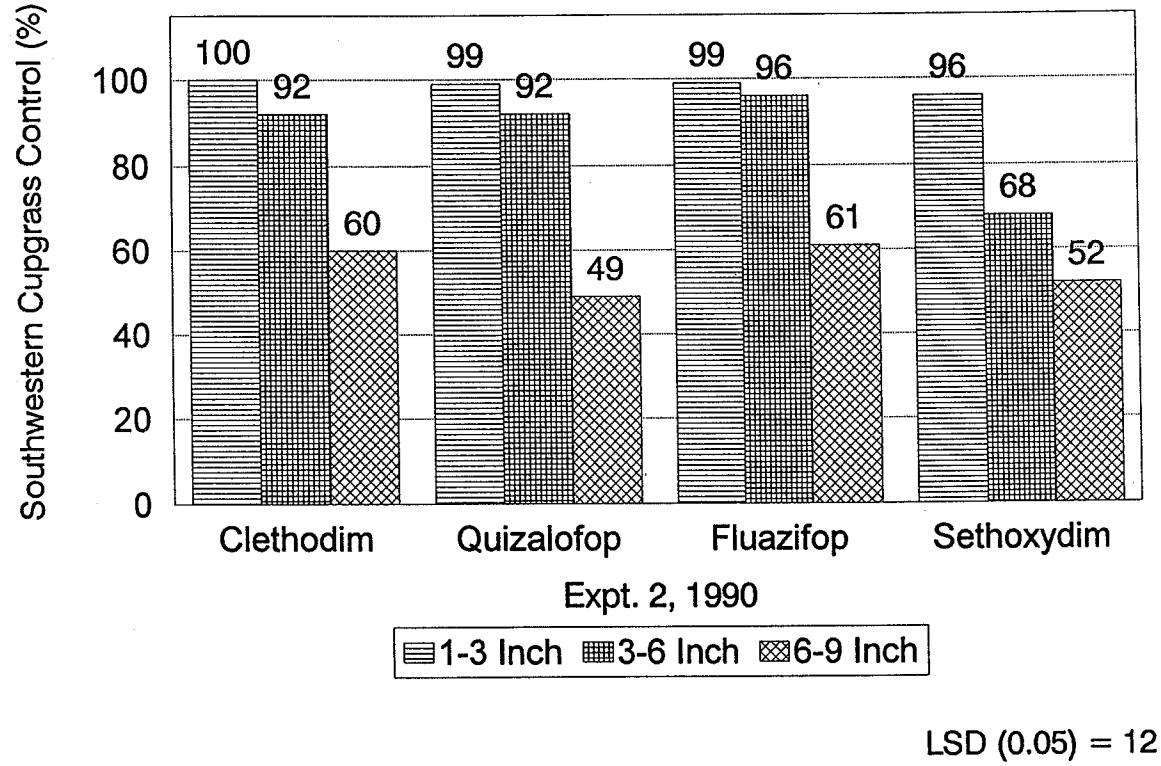

Figure 6. Southwestern cupgrass control at 14 DAT with various herbicides applied at three weed stages.

control at the 1- to 3-inch, 3- to 6-inch, and 6- to 9-inch stage, respectively, in Experiment 1, and greater than 99% control in Experiment 2 (Figures 3 and 4). Control was greater than 96% at all stages with quizalofop in both experiments.

In the first experiment, control was 94%, 72%, and 61% with fluazifop-p at each respective stage (Figure 3). However, control was 100% at the 1- to 3-inch and 3- to 6-inch stage and 90% at the 6- to 9-inch stage in the second experiment (Figure 4). Sethoxydim results were similar to fluazifop-p. In the first experiment, sethoxydim resulted in 98%, 78%, and 82% control (Figure 3) while control was greater than 98% for all growth stages in the second experiment (Figure 4). Differences in control in each experiment were attributed to varying soil moisture conditions at the time of application.

Southwestern Cupgrass Control

In 1990, clethodim resulted in 100% control for the 1- to 3-inch and 3- to 6-inch growth stages in the first experiment, while providing less than 70% control for the 6- to 9-inch stage (Figure 5). In the second experiment, clethodim results were similar (Figure 6). In both experiments, quizalofop resulted in greater than 99% control at the 1- to 3-inch stage, up to 92% control for the 3- to 6-inch stage, and less than 61% control for the 6- to 9-inch stage (Figures 5 and 6).

Control was greater than 99% at the 1- to 3-inch stage and was 96% for the 3- to 6-inch stage when fluazifop-p was applied in each experiment (Figures 5 and 6). Less than 66% was controlled with fluazifiop-p at the 6- to 9-inch stage for both experiments. Application of sethoxydim resulted in greater than 96% control at the 1- to 3-inch stage. Control at the 3- to 6-inch stage was 91% in the first experiment but was lower than 68% in the second experiment. Control with sethoxydim dropped below 55% at the 6- to 9-inch stage in both experiments.

Conclusions

For the rates evaluated, clethodim, quizalofop, and fluazifop-p are recommended for the control of johnsongrass, barnyardgrass, and southwestern cupgrass at the 1- to 3-inch and 3- to 6-inch stage. Control of johnsongrass, barnyardgrass, and southwestern cupgrass with sethoxydim was best at the 1- to 3-inch stage only. Sethoxydim at later growth stages resulted in inconsistent control. Control of southwestern cupgrass with clethodim and fluazifop was best when treated before the 6- to 9-inch stage.

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