Weed Technology. 1997. Volume 11:667–671

Longspine Sandbur (*Cenchrus longispinus*) Ecology and Interference in Irrigated Corn (*Zea mays*)[1]

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Abstract: Longspine sandbur is a troublesome weed infesting corn in the Great Plains. However, herbicides are now available to control this species. This study characterized longspine sandbur ecology in irrigated corn to aid producers in integrating herbicides into their production systems. Longspine sandbur began emerging May 25, and by June 15, 84% of the seasonal emergence had occurred. Plant development was related to cumulative growing degree days. Seeds were viable early in longspine sandbur's development, with 20% of seeds viable by heading. Producers can minimize seed production of longspine sandbur in field borders by mowing plants at the boot stage. Bur production per plant was related to time of emergence, with seedlings emerging in late May producing 1,120 burs per plant. Seedlings emerging 4 wk later produced 84% fewer burs. Controlling longspine sandbur before 4 wk of interference prevented loss of corn grain yield.

Nomenclature: Longspine sandbur, *Cenchrus longispinus* (Hack.) Fern. #[3] CCHPA; corn, *Zea mays* L. 'Pioneer Brand 3732.'

Additional index words: Bur production, growing degree day accumulation, herbicides, plant development, CCHPA.

Abbreviations: GDD, growing degree day; N, nitrogen; POST, postemergence.

INTRODUCTION

Longspine sandbur is a difficult-to-control annual weed infesting corn in the Great Plains[4] (Peterson et al. 1993; Wicks 1985). Preemergence herbicides currently available perform poorly on longspine sandbur, unless they are mechanically incorporated into soil (Phillips 1969; Todd et al. 1984; Wiese and Chenault 1986). Producers are concerned with protecting their soil resource; thus, they are seeking production systems that minimize tillage (Peterson et al. 1993; Wyse 1994).

Nicosulfuron {2-[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-*N,N*-dimethyl-3-pyridinecarboxamide} controls longspine sandbur when applied postemergence (POST) (Anderson 1989; Wilson 1993). In addition, other POST herbicides have been developed for grass control in corn (Swanton et al. 1996; Tweedy and Kapusta 1995).

With these new herbicides, producers can use production systems that minimize tillage yet still control longspine sandbur. Knowledge of a weed's emergence and plant development can help producers plan effective management strategies (Staniforth and Wiese 1985). For example, herbicide activity is affected by grass development (Harrison et al. 1985; Neal et al. 1990). Control decreased 20 to 30% when giant foxtail (*Setaria faberi* Herrm.) was tillering compared with pretillering at time of graminicide application (Derr et al. 1985).

To aid producers in selecting control strategies, scientists are developing decision aid models (Lybecker et al. 1991; Swinton and King 1994). These models incorporate ecological data of selected weeds, such as seedling emergence patterns, to predict long-term consequences of various management options (Wiles et al. 1996). Longspine sandbur's emergence pattern has been described in Washington (Boydston 1990). However, the emergence pattern of a species may differ between regions (Aldrich 1984). For example, redroot pigweed (*Amaranthus retroflexus* L.) emerges 1 mo earlier in Washington than in Colorado, a difference that could not be attributed to air temperature (Anderson and Nielsen 1996). In addition, models use knowledge of seed production of individual plants to predict seedbank dynamics and guide future crop choices (Swinton and King 1994).

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[1] Received for publication March 27, 1997, and in revised form May 27, 1997. Contribution from Agricultural Research Service, United States Department of Agriculture.

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[3] Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds*, Revised 1989. Available from WSSA, 810 East 10th Street, Lawrence, KS 66044-8897.

[4] Wicks, G. A. and R. G. Wilson, Jr., 1994, Sandbur control in corn, University of Nebraska NebGuide, G74-121-A.

site were placed in paper bags and stored in a greenhouse until viability assessment was conducted 4 mo later. Seeds were separated from burs (50 seeds for each development stage per site), placed between layers of moist standard germination paper in petri dishes, and germinated at 18 C/10 C (day/night) temperatures for 14 d. Seeds that did not germinate were tested for viability with tetrazolium (Moore 1976). Seeds were cut in half and placed in a solution of 2,3,5-triphenyltetrazolium solution (1% aqueous solution of tetrazolium chloride) for 3.5 h. Seeds were assessed for viability by red staining of the embryo. Viability values are the sum of germination and tetrazolium data.

Critical Period of Interference Study. Longspine sandbur was removed by hoeing 2, 3, 4, and 5 wk after initiation of emergence (May 25) in 1989 and 1990. When the 2-wk removal treatment was initiated, corn had four leaves fully emerged, with seven leaves fully emerged at the 5-wk treatment. Treatments were maintained weed free for 7 d. Weed-infested and weed-free controls also were established. Weeds were removed from the weed-free control treatment weekly. Plot size was 4 by 8 m, with four replications. Longspine sandbur density at corn tasseling was approximately 150 plants/m^2. Corn yield was determined using a plot combine, harvesting a 15-m^2 area from each plot. Grain yield was standardized to 15.5% moisture content, with treatment means expressed as percent yield loss compared with the weed-free control.

Data Analyses. Experimental design was a randomized complete block for the plant development and critical period of interference studies. The seed viability study was a completely randomized design. Treatment means were analyzed by ANOVA, and if the *F*-test was significant, means were compared with LSD at the 0.05 level of probability. Treatment by year interactions did not occur; therefore, data were averaged across years.

RESULTS AND DISCUSSION

Seedling Emergence. Longspine sandbur began emerging May 25, with 84% of seasonal emergence occurring by June 15, a 4-wk period (Figure 1). Emergence continued until early August.

Producers can plan more effective control strategies if they are able to predict when longspine sandbur emergence occurs. Roberts and Feast (1973) suggested that initial seedling emergence of weeds is governed by a temperature threshold, such that when air temperatures reach a specific level, seedling emergence begins if moisture is available. Stoller and Wax (1973) also suggested a temperature threshold; however, they found that GDD accumulation did not correlate with seedling emergence. Egley (1986) reported that amplitude of daily temperature fluctuation most accurately described temperature effect on seedling emergence.

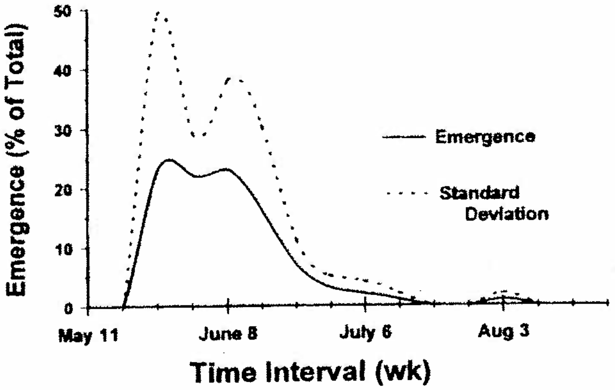

Figure 1. Longspine sandbur seedling emergence, averaged over 3 yr. Dotted line represents one standard deviation.

Following Egley's guidelines, daily air temperature fluctuation during the 7-d period before initial seedling emergence was calculated and averaged across 3 yr. Longspine sandbur began emerging when the maximum and minimum daily temperatures were 25.4 C ± 4.8 and 8.8 C ± 2.5, respectively. The average daily temperature was 17.0 C ± 3.2. Longspine sandbur begins emergence in Colorado in late May, which contrasts with emergence in Washington, where seedlings began emerging in mid-April (Boydston 1990). However, this difference in time can be attributed to temperature, as emergence in Washington began when soil temperature at 2.5-cm depth averaged 15 to 20 C, a temperature range similar to this study. However, longspine sandbur duration of emergence differed between the two regions, as seedlings continued to emerge through October in Washington, contrasting with the Colorado site, where seedlings did not emerge after early August (Figure 1).

Plant Development. Longspine sandbur development was affected by its time of emergence. Seedlings emerging on May 25 began heading 75 d later, while seedlings emerging July 5 headed 49 d later (data not shown). This time difference was not related to temperature, as GDD accumulation by heading was 35% less for seedlings emerging on July 5. However, seedlings emerging in May and June developed similarly (data not shown). Thus, to aid producers in assessing development, rate of plant development for this time period was related to GDD accumulation (Figure 2). Seedlings began tillering

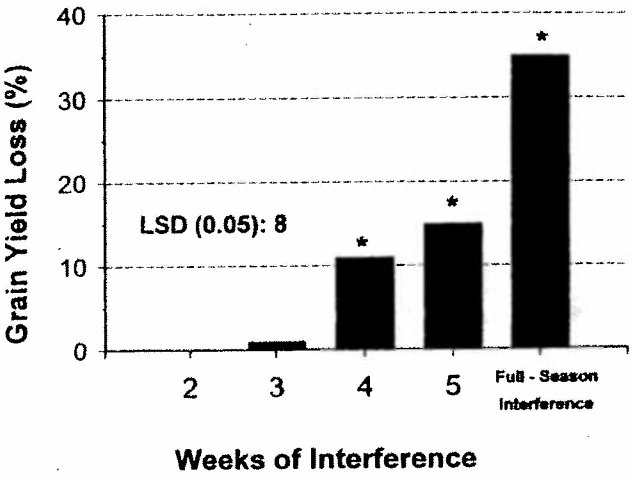

Figure 4. Effect of duration of longspine sandbur interference on grain yield of irrigated corn. Treatment means were expressed as percent yield loss compared to the weed-free control. Treatment means differing from the weed-free control are designated with an asterisk.

GDD, seedlings emerging in late May will tiller by June 22 with average temperatures in Colorado.

Another consideration, however, is that controlling seedlings too early allows seedlings that emerge after the herbicide application to produce considerable seeds (Figure 1; Table 1). For example, seedlings emerging June 8 produced more than twice the number of burs as seedlings emerging June 22 (Table 1). In addition, the grass herbicides may have application restrictions based on corn growth stage. Nicosulfuron can be applied only with drop nozzles if corn has more than six leaves.[7] In this study, corn developed seven leaves by July 1 (data not shown).

The data from this study suggest that a POST grass herbicide should be applied near June 15 to produce the most favorable results related to all factors. Decision aid models that integrate longspine sandbur ecological characteristics with assessing management strategies for herbicides could help producers in predicting long-term consequences of their decisions.

ACKNOWLEDGMENTS

The technical assistance of Sonya Hamilton, Karen Henson, and Donna Fritzler is gratefully acknowledged.

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[7] Accent herbicide product label, E. I. du Pont de Nemours and Company, Wilmington, DE 19898.