Grain Sorghum Desiccation with Sodium Chlorate and Paraquat in the Texas Rolling Plains

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ABSTRACT

Grain sorghum [*Sorghum bicolor* (L.) Moench] is frequently planted in late June and early July in many parts of the Rolling Plains. Late planting results in grain maturing under unfavorable environmental conditions, prolonging high grain moisture content. Field studies were conducted at the Chillicothe Research Station, Chillicothe, Texas to evaluate grain sorghum desiccants that could accelerate grain moisture loss. Desiccation treatments of sodium chlorate at 6.7 and 13.4 kg/ha or paraquat at 0.7 and 1.4 kg/ha were applied to a medium-late-maturing grain sorghum hybrid. In both years, desiccation treatments did not affect grain moisture loss during the 16 days after treatment. These results indicate that desiccants are generally ineffective in reducing grain moisture for late-planted sorghum in the Rolling Plains of Texas especially when grain moisture is < 24% at application and high relative humidity follows desiccant application.

KEYWORDS: chemical desiccants, grain moisture loss, *Sorghum bicolor*

INTRODUCTION

Grain sorghum production in Texas exceeds 1.2 million hectares most years. However, production in the Rolling Plains is less stable than other areas of the state due to dryland production and periodic droughts that greatly affect yield. From 1994 to 1998, planted hectares in Districts 2N and 1S (comprising most of the Rolling Plains) has varied from 42 to 93 thousand hectares. Harvested hectares as a percentage of planted hectares also varies greatly depending on environment: from a high of 91% in 1997 to a low of 36% in 1998. Generally, 75 to 90% of the planted hectares is harvested for yield[1]. Many of the hectares are planted in early spring.

Late grain sorghum planting (late June/early July) in the northern Rolling Plains normally results in higher yields (Clark, 1997), but maturity is delayed into fall when environmental conditions are not as favorable for grain moisture loss as when grain matures in the heat of summer. Ideally, grain sorghum should be harvested when seed moisture content is < 13%. Local grain handling facilities are not equipped to dry sorghum to a suitable level for storage. Therefore, a hard freeze is typically necessary to kill late-planted sorghum

[1] Texas Agricultural Statistics,1994 to 1998. Compiled by the Texas Agricultural Statistics Service, United States Department of Agriculture and Texas Department of Agriculture. P.O. Box 70, Austin, TX 78767.

plants and subsequently dry the grain to acceptable harvest moisture levels. Cool weather delays grain moisture loss and harvest. Delay in harvesting increases lodging and bird damage and reduces seed quality and yield (Clark 1997). Previous research with grain sorghum by Bovey and McCartey (1965) demonstrated that the chemical desiccants such as magnesium chlorate and diquat {6,7-dihydrodipyrido[1,2-%:2',1'-c]pyrazinediium ion} applied to the leaves and head will accelerate grain moisture loss when moisture contents were initially high; i.e. 38% or above. Desiccation treatments were less effective when initial seed moisture was 32% or less. Other chemicals such as paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) and cacodylic acid (dimethyl arsinic acid) applied to grain sorghum also enhanced leaf desiccation of mature stands (Bovey and Miller 1968). Regehr et al. (1996) observed significant decreases in grain moisture over a 3-wk period when grain sorghum was treated with either sodium chlorate or diquat at an initially high grain moisture content of 49%. Donnelly et al. (1977) documented accelerated grain moisture loss from a foliar nitrogen application until grain moisture content reached 20 to 25%. At this point, rainfall and high humidity negated any additional grain moisture loss. There is no information on the effects of desiccation treatments on grain moisture loss with late-planted grain sorghum in a semi-arid environment such as the Rolling Plains.

The objective of this paper is to determine if chemical desiccation treatments of sodium chlorate and paraquat are effective in accelerating harvest maturity following black layer formation (i.e. physiological maturity of the grain) in a medium-late-maturing grain sorghum hybrid planted late in the season in the Texas Rolling Plains.

MATERIALS AND METHODS

A medium-late-maturing hybrid (W625Y) was planted into an Abilene clay loam (fine, mixed, thermic, Pachic Arguistoll) at 11.5 and 13 seeds/m on 26 June 1998 and 8 July 1999, respectively, at the Texas Agricultural Experiment Station near Chillicothe, TX. The area was fertilized with 56 kg/ha N and 34 kg/ha P on 26 June 1998 and 7 July 1999. Propazine at 0.9 kg/ha was applied for early season weed control on 27 June 1998 and 9 July 1999, whereas pendimethalin at 0.84 kg/ha was applied and incorporated with a rolling cultivator on 7 August 1998 and 6 August 1999 for late season weed control. Plots consisted of four rows on 1-m centers and 4.9 m long. The site was pre-watered and received only one additional irrigation in each year. When about 50% of the sorghum kernels reached black layer or physiological maturity, sorghum was treated over the top with either sodium chlorate at 6.7 and 13.4 kg/ha or paraquat at 0.7 and 1.4 kg/ha. A non-ionic surfactant, Latron AG-98, was added with paraquat at 0.25% v/v. Treatments were applied on 19 October 1998 and 4 November 1999. Dessicants were applied at 140 L/ha using a CO - propellant sprayer equipped with four Turbo-Teejet 11002 nozzles[2] spaced 51 cm apart. Grain sorghum heads were harvested from the center 4-m section of a single row at 0, 4, 8, and 16 days after treatment (DAT), threshed with a plot combine, and grain moisture determined.

The experiments were arranged as a randomized complete block design with four replicates per treatment. Data were analyzed using analysis of variance, and means were separated with a Least Significant Difference (LSD) at 0.05. The interactions tested were the 4-way interaction of year by harvest interval by chemical treatment by application rate, and then all subsequent 3- and 2-way interactions were tested.

RESULTS AND DISCUSSION

Desiccation treatment combinations of chemical treatment by application rate had no affect on grain moisture loss. The only effect that was recorded was harvest interval

[2]Spraying Systems Co., North Ave. at Schmale Road, Wheaton, IL 60189.

within year. As expected, grain moisture decreased over time (Table 1). In both years, desiccants were applied to grain sorghum with moisture ranging between 19 and 25% (Table 2). The lower grain moisture content probably attributed to the desiccants ineffectiveness at drying down the grain. These results do not exhibit the same level of grain moisture loss observed by Regehr et al. (1996) and Bovey and McCartey (1965). In several of their treatments, grain sorghum was desiccated when initial grain moisture content exceeded 30%, resulting in significant moisture loss compared with non-treated grain. However, application of desiccants to grain with moisture content less than 30% was much less effective in reducing grain moisture content. Additionally, high relative humidity following desiccant application may have reduced the efficacy of the desiccants (Table 3). Donnelly et al. (1977) noted little benefit from urea-ammonium nitrate desiccation treatments when initial grain moisture content was lower than 20 to 25% and relative humidity was high.

Table 1. Grain moisture 4, 8, and 16 days after treatment. Grain moisutre data were combined across harvest dates and treatments.

Harvest interval	Grain moisture	
Days	1998	1999
0	24.4	19.3
4	25.1	16.9
8	20.5	15.5
16	18.1	13.0
LSD (0.05)	----------0.8----------	

Table 2. Grain sorghum moisture content for each chemical treatment by application rate and harvest interval combination in each year at 4, 8, and 16 days after treatment.

Year	Treatment	Rate	Grain Moisture*		
		kg ai/ha	4	8	16
			----------%----------		
1998	Sodium Chlorate	6.7	24.7	21.7	18.5
		13.4	26.3	20.2	17.9
	Paraquat	0.7	24.7	20.2	17.7
		1.4	25.2	20.6	17.3
	No treatment		24.5	20.0	19.2
1999	Sodium Chlorate	6.7	16.5	16.2	13.3
		13.4	17.1	15.7	13.0
	Paraquat	0.7	17.4	15.6	12.9
		1.4	16.7	15.4	12.4
	No treatment		16.9	14.8	13.3
LSD (0.05)			NS	NS	NS

*Initial grain moisture content on date of treatment was 24.4% and 19.3% in 1998 and 1999. respectively.

Table 3. Maximum (max) and minimum (min) relative humidity (%) from the day of desiccant application to 16 days after treatment in 1998 and 1999.

DAT	1998		1999	
	max	min	max	min
1	100	32	92	89
2	96	20	93	89
3	98	80	94	42
4	98	30	97	38
5	100	30	91	38
6	100	32	81	42
7	100	20	93	37
8	100	34	-	-
9	98	68	88	30
10	98	50	-	-
11	98	30	-	-
12	98	16	82	29
13	100	54	92	26
14	100	100	82	22
15	100	80	84	22
16	100	60	76	27
	98	70	-	
Ave.	99	47	89	41

Although the desiccants were ineffective in this environment, desiccants may provide better grain dry down under more favorable environment conditions. However, the possibility of observing a small decrease in grain moisture may not justify the application cost of paraquat or sodium chlorate which ranges from $3.00 to $9.00/ha.

With current grain prices, dryland grain sorghum production in the Texas Rolling Plains is marginally profitable, even in years with favorable environments. Desiccating plants when the majority of the sorghum kernels have not reached physiological maturity and are still high in moisture content will most likely result in yield loss, further reducing profitability.

Results from our 2-yr study indicate that desiccant applications were generally ineffective (and most likely uneconomical) in reducing grain moisture in late-planted grain sorghum.

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