Kansas Agricultural Experiment Station Research Reports

Volume 8
Issue 8 *Western Kansas Agricultural Research*

Article 1

2022

Forage Crop Water Use and Production Under Dryland Conditions

R. Aiken
Kansas State University, raiken@ksu.edu

F. Lamm
Kansas State University, flamm@ksu.edu

Recommended Citation

Aiken, R. and Lamm, F. (2022) "Forage Crop Water Use and Production Under Dryland Conditions," *Kansas Agricultural Experiment Station Research Reports*: Vol. 8: Iss. 8. https://doi.org/10.4148/2378-5977.8329

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Abstract

Forage crops contribute diversity and buffer agronomic risk in water-limited cropping systems. Knowledge of growth responses to uncertain water supply can help guide crop selection and management—including timing of harvest. Our research objective was to determine water use and growth responses of forage winter triticale and forage sorghum under rainfed conditions.

Keywords

water use, forage production, dryland, forage winter triticale, forage sorghum

Cover Page Footnote

Sadly, Freddie Lamm passed away during the process of publishing this report, May 26, 2022. 30-year normal conditions taken from https://www.usclimatedata.com/ climate/colby/kansas/united-states/ usks0120

Forage Crop Water Use and Production Under Dryland Conditions

R. Aiken and F. Lamm[1]

Introduction

Forage crops contribute diversity and buffer agronomic risk in water-limited cropping systems. Knowledge of growth responses to uncertain water supply can help guide crop selection and management—including timing of harvest. Our research objective was to determine water use and growth responses of forage winter triticale and forage sorghum under rainfed conditions.

Experimental Procedures

Forage winter triticale (FWT, NE 422T) and forage sorghum (FS, Sorghum Partners 405) were grown in alternate years of a two-year crop sequence, beginning in 2008. The study site, located at the Kansas State University Northwest Research-Extension Center (39.4 N, 100.1 W), was established on a Keith silt loam soil. Typically, FWT was drilled (Great Plains 2000 drill, 7.5-in. row spacing, 75 lb/a) in late September; FS was planted (John Deere 7300 planter, 30-in. row spacing, 50,000 seed/a) in early June. Soil fertility was supplemented with 60 lb N/a and 30 lb P_2O_5/a prior to planting for both FWT and FS. A pre-emergent herbicide (*S*-metolachlor) was applied after FS planting; weeds emerging after planting were controlled by a post-emergent herbicide such as Starane (Fluroxypyr) for both FS and FWT; contact herbicides (glyphosate, 2,4-D) controlled weeds after FWT harvest. Experimental plots (40 × 80 ft) were included in a larger cropping sequence study with randomized treatment assignment to each of three replicate blocks. Both FWT and FS phases were present each year.

Harvest was generally taken at boot, milk, and soft-dough stages by hand sampling. Fresh weight was adjusted to dry weight basis using samples taken for water content determination (dried to constant weight). Effective water use was calculated from precipitation and soil water depletion (early vegetative growth to harvest, by neutron thermalization to 8-ft depth). Heat stress degree days were calculated from daily maximum temperatures greater than 90°F. Linear regression was used to determine the relationship of above-ground biomass production with water use and interpreted as an indicator of crop water productivity.

Results and Discussion

Growing conditions at the NWREC study site were generally representative of the conditions observed at Colby for the 30-year normal[2] (1981–2010, Table 1). Effective

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[2] 30-year normal conditions taken from https://www.usclimatedata.com/climate/colby/kansas/united-states/usks0120.

water use differed among years and increased for harvest with later development stages for both FWT and FS. Above-ground biomass increased with effective water use for both FWT (Figure 1) and FS (Figure 2). The water productivity of FS exceeded that of FWT, based on the greater slope in the relationship of biomass productivity with water use. Heat stress decreased forage productivity of FWT and FS by 257 lb/a and 466 lb/a, respectively, for each 10°F in cumulative heat stress degree days (temperatures exceeded 90°F; data not shown). Farmers in the region can refer to these figures to estimate productivity, given a range of anticipated water supply and weather conditions.

Table 1. Quarterly precipitation and growing season maximum temperature for forage winter triticale and forage sorghum during the 2008–2020 period, in comparison with the 1981–2010 normal, for Colby, KS

	Average precipitation (in.)				Average maximum temperature (°F)				
	Jan-Mar	Apr-June	July-Sept	Oct -Dec	May	June	July	Aug	Sept
2008 – 2020	1.88	8.13	7.67	2.46	74	88*	91	88	82
1981 – 2010	2.01	7.86	8.00	2.78	74	85	91	89	80

* The June average maximum temperature during the study period was significantly greater than that of the 30-year normal (P = 0.10).

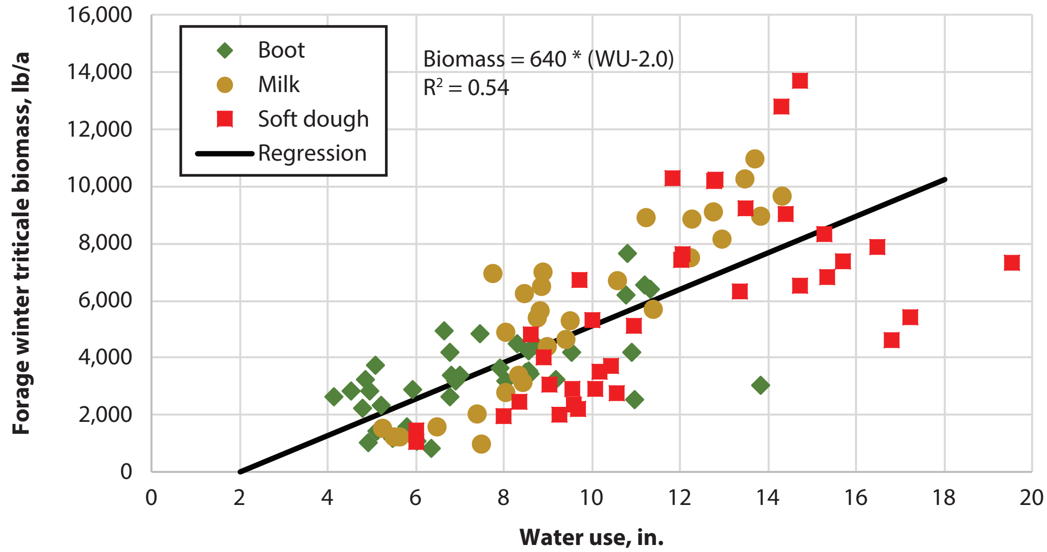

Figure 1. Above-ground biomass (dry matter) of forage winter triticale in relation to seasonal water use for crop harvested at boot, milk, or soft dough stages. Crops were grown in rotation with forage sorghum at Colby, KS, during 2008 through 2020 growing seasons. Each symbol represents values obtained for individual plots in the various years.

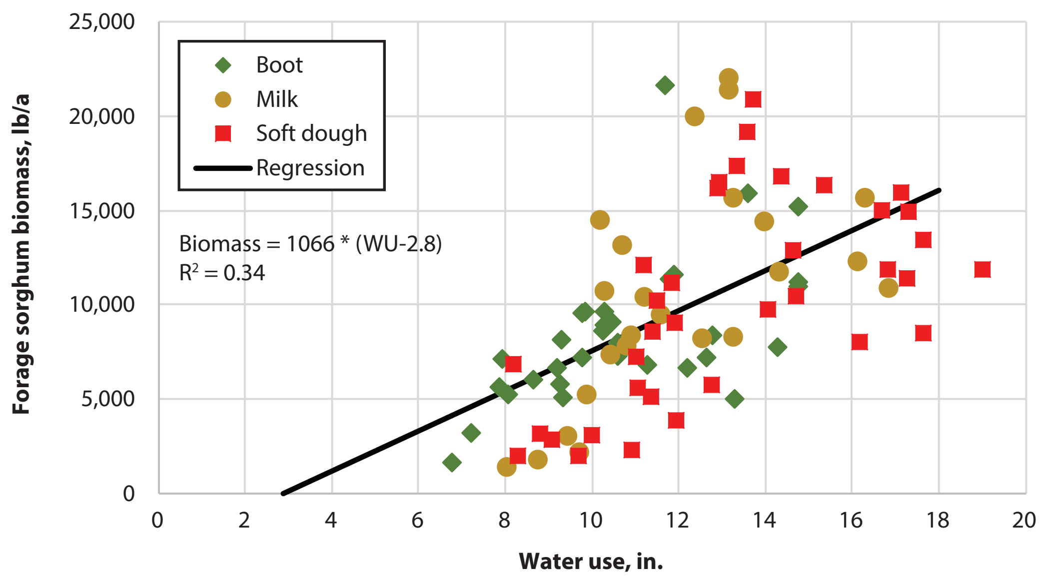

Figure 2. Above-ground biomass (dry matter) of forage sorghum in relation to seasonal water use for crop harvested at boot, milk, or soft dough stages. Crops were grown in rotation with forage winter triticale at Colby, KS, during 2008 through 2020 growing seasons. Each symbol represents values obtained for individual plots in the various years.