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Forage Productivity of Triticale and Winter Small Grain Mixtures in the Texas Rolling Plains

Abstract

Triticale (x *Triticosecale* Wittmack) is gaining attention by winter wheat pasture owners in the Texas Rolling Plains due to its high forage mass potential. Triticale can extend the grazing window and fill the gap in the early summer when forage productivity of winter wheat pasture is declining. This study evaluated forage mass of small grain and triticale mixtures at various ratios (0:100, 30:70, 50:50, 70:30, and 100:0) for three years (2017/2018-2019/2020). Total forage mass increased as triticale ratio increased in the mixtures during a wet year ($p < 0.0003$). There were no differences among treatments in dry or drought years ($p > 0.05$).

Introduction

Winter wheat (*Triticum aestivum* L.) is commonly utilized for winter pasture in the Texas Rolling Plains (Kumssa et al., 2019). Planting begins in mid-September when soil temperature cools down to below 80℉ (Lafond and Fowler, 1989; Marburger, 2017). The winter wheat pasture can be grazed from mid-November through April. Forage availability declines after April until perennial summer pasture (e.g., bermudagrass (*Cynodon dactylon*)) becomes available in June to July in the region. Therefore, hay needs to be purchased to feed livestock during May to mid-June.

Triticale is gaining attention by the winter wheat pasture owners in the Texas Rolling Plains due to the high forage mass potential (Ayalew et al., 2018; Lauriault et al., 2022). Triticale is a hybrid between wheat and rye (*Secale cereale* L.) and typically is resistant to rust and other diseases and has larger seeds than wheat seeds (Li et al., 2007). Triticale can extend the grazing window and fill the gap in the early summer when forage productivity of winter wheat pasture is declining (Rao et al., 2000). However, seed cost is more expensive for triticale than wheat. Combining triticale with other small grain species may optimize seed cost while maintaining adequate forage productivity. This study was conducted to determine the optimum seed mixture of winter small grains and triticale among five ratios at 0:100, 30:70, 50:50, 70:30, and 100:0 under dryland conditions.

Materials and Methods

The three-year study was conducted in 2017/2018 (year 1), 2018/2019 (year 2), and 2019/2020 (year 3) at the three sites in the Texas Rolling Plains. In year 1, the study was conducted at Harrold, TX, while year 2 and 3 trials were conducted at Harrold, Crowell, and Weinert, TX (Table 1). All trials were coordinated with County Extension Agents and placed on-farm with grower cooperators, where field day events were held each year. Cultivars used for the study were TriCal 348 triticale and TAM 401 (Rudd et al., 2012) or TAMbar 501 (Marshall et al., 2003) for winter small grains (Table 2). TAM

401 and TAMbar 501 are comparable only on the potential forage mass and maturity characteristics; however, they were not comparable in terms of the recommendation to a producer. There were no wheat varieties with similar characteristics (forage mass and maturity) to replace TAM 401 when TAM 401 was discontinued. Therefore, we used TAMbar 501 to replace the TAM 401. Full maturity cultivar was used for triticale, while early maturity was used for small grain cultivars. The intention of mixing two opposite maturity characteristics was to provide early winter forage from the early maturity species and early summer forage from the late maturity species. The forage mass by clipping timing data were intended to present to describe how each mixture treatment would produce differing amount of forage mass per clipping timings. However, due to the lack of moisture in the fall, October-November clippings were not conducted, and the total forage mass was presented in the current paper instead of forage mass per clipping timing. Triticale was mixed with wheat for year 1 and 2 and barley for year 3 as TAM 401 was not available. Five ratios included 0:100 (e.g., 0% small grain and 100% triticale), 30:70, 50:50, 70:30, and 100:0. Final seeding rate for each mixture was adjusted to 1.4 million seeds per acre. Plot size was 5-ft wide and 10-ft long with 7-inch spacing between rows. The study was designed as a Randomized Complete Block Design with three replications. Soils were sampled to a 6-in depth each year, and nitrogen fertilizer was applied at 90 lb per acre rate at top dressing in February. Forage was clipped from a randomly selected two rows by one foot area from each plot. The selected area was clipped by a clipper to the 2-in stubble height. Clipping was conducted when the forage height reached at least 10-inch height from the ground to the tip of the leaf. After clipping, whole plots were mowed to the same stubble height. Clipped samples were dried in the air-forced dryer for 72 hours. Dried samples were weighed to estimate forage mass in lb per acre basis. The study was analyzed by SAS 9.4 (SAS Institute Inc. 2013), using a mixed procedure. Location, cultivars, and replications were treated as random effects, while years and mix ratios were treated as fixed effects. A fixed effect was used for year for this study because the year variation had important effects on the forage mass results. This would allow growers to understand how the forage mass differed by varying weather patterns in the region.

Table 1. Site description, forage mixture used, and dates for planting and clippings for the study in year 1 (2017/2018), year 2 (2018/2019) and year 3 (2019/2020).

	Harrold	Crowell	Weinert
Location	34°10'45.4"N 99°03'19.8"W	33°59'13.8"N 99°40'51.7"W	33°21'17.6"N 99°31'03.3"W
Soil characteristics	Tipton loam, 0 to 1 percent slopes	Rotan clay loam, 0-1 percent slopes	Silky clay loam, 0 to 1 percent slopes
Tillage	Conventionally tilled	Conventionally tilled	No-till
		Year 1	
Mixture	Triticale: Wheat	-	-
Planting date	17 October 2017	-	-
Clipping 1	1 March 2018	-	-
Clipping 2	9 May 2018	-	-
		Year 2	
Mixture	Triticale: Wheat	Triticale: Wheat	Triticale: Wheat
Planting date	3 October 2018	9 November 2018	4 October 2018
Clipping 1	20 December 2018	-	-
Clipping 2	5 February 2019	-	4 February 2019
Clipping 3	6 March 2019	-	7 March 2019
Clipping 4	11 April 2019	30 May 2019	11 April 2019
		Year 3	
Mixture	Triticale: Barley	Triticale: Barley	Triticale: Barley
Planting date	2 October 2019	2 October 2019	3 October 2019
Clipping 1	24 January 2020	-	24 January 2020
Clipping 2	21 February 2020	21 February 2020	21 February 2020
Clipping 3	13 May 2020	12 May 2020	14 May 2020

Table 2. Cultivar characteristics for winter triticale TriCal 348, winter wheat TAM 401, and winter barley TAMbar 501.

	TriCal 348	**TAM 401**	**TAMbar 501**
Species	Winter triticale	Winter wheat	Winter barley
Awn	Awnletted	Awnless	Awned
Maturity	Late	Early	Early

Results and Discussion

Early maturity small grain and full maturity triticale cultivars were mixed for evaluating the seasonal forage mass in rainfed conditions. Rainfall levels were considered drought, wet, and dry for year 1, 2, and 3, respectively (Table 3).

Table 3. In-season precipitation from October to May at Harrold, Crowell, Weinert, TX.

	Year 1 (Drought year)			**Year 2 (Wet year)**			**Year 3 (Dry year)**		
	Harrold	Crowell	Weinert	Harrold	Crowell	Weinert	Harrold	Crowell	Weinert
	inch								
Oct	1.04	0.16	0.42	7.31	6.60	10.6	0.67	0.30	0.13
Nov	0.06	0.09	0.52	1.08	1.05	1.76	1.46	1.97	3.09
Dec	0.08	0.06	0.18	1.63	1.08	2.47	0.33	0.42	0.39
Jan	0.09	0.07	0.21	0.66	0.54	0.66	2.30	2.39	1.93
Feb	0.92	0.85	1.13	0.08	0.19	0.27	1.34	0.95	2.24
Mar	0.65	0.60	1.72	1.55	1.12	2.76	3.57	2.60	4.44
Apr	0.54	0.43	0.27	5.87	5.10	5.86	0.54	0.51	0.85
May	4.52	5.72	2.63	6.87	5.11	5.02	6.88	2.77	3.10
Total	**7.90**	**7.98**	**7.08**	**25.1**	**20.8**	**29.4**	**17.1**	**11.9**	**16.2**

Data were obtained from the National Weather Service.

In year 2 (wet year), total forage mass was significantly greater in the treatment with high triticale ratios ($p < 0.0003$; Table 4). Forage mass of the triticale only treatment was 11,590 lb per acre as compared to 6,653 lb per acre for the wheat only treatment (Table 4). This is in an agreement with a study conducted in southern Oklahoma, where triticale produced greater forage mass than winter wheat ($p > 0.05$) (Kim et al., 2017). In the study conducted by Kim et al. (2017), amount of precipitation received during the study period ranged between 22.2 to 29.2 inches. This is similar rainfall level as the year 2 of the current study.

In year 1 (drought year) and 3 (dry year), total forage mass among all treatments had no significant difference ($p > 0.05$), indicating that there was no yield advantage of triticale in the mixtures. This indicates that forage mass can be maximized with triticale with high available soil moisture (e.g., rainfall and/or irrigation). A study conducted in California compared water use efficiency of triticale and wheat. Wheat produced 3% more grain yield ($p < 0.05$) in water-limited environments, while water use efficiency of triticale improved in the high soil moisture and N environments (Tamagno et al., 2022). Brown and Almodares (1976) showed that the forage mass of triticale was similar or greater than other small grains (rye, wheat, and oat), while crude protein content was similar at comparable growth stages in southeast US. Average forage mass over the three years was significantly greater for all ratios except for 100% small grain (wheat or barley) ($p < 0.0141$; Table 4).

Table 4. Forage mass for the small grains and triticale mixture during 2017 to 2020 and three-year average.

Year	**2017/2018 (Drought)**	**2018/2019 (Wet)**	**2019/2020 (Dry)**	**3-yr average**
Small grains: Triticale ratio	lb per acre			
0:100	6016	11590^{A1}	15773	11127^{A}
30:70	5942	10316^{AB}	15456	10571^{AB}
50:50	6603	8852^{BC}	14284	9913^{B}
70:30	7312	8158^{CD}	14794	10088^{AB}
100:0	6036	6653^{D}	12166	8285^{C}
Mean	**6382**	**9114**	**14495**	**9997**
p	**NS**	**0.0003**	**NS**	**0.0141**

[1]Values with different alphabet are significantly different at $p < 0.05$.

Conclusion

Early maturity small grain (wheat or barley) and full maturity triticale cultivars were mixed at different ratios for evaluating the seasonal forage mass. Wheat growers in the Texas Rolling Plains regions experience highly variable weather patterns each year, and there is no “typical” weather for a stable forage production. The study showed that adding triticale into other small grain species significantly increased forage mass in the wet year. It is expected that in a year with lower-than-average rainfall amount, total forage mass may be lower than average, and there was no advantage of including triticale in the mixture due to its higher seed cost than wheat seeds. The results of this study provide cool-season annual pasture options for winter wheat producers in the Texas Rolling Plains.

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