The business case for healthy grasslands-based agriculture – economic and social implications.

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Abstract

Native perennial warm-season grasses (NWSGs) of the United States (U.S.) provide valuable summer forage. Studies have shown their potential within grazing systems as a complement to cool-season forages, as well as their benefits to soil biota, wildlife biodiversity, carbon sequestration and their resiliency to extreme drought and flood events. In this paper, we demonstrate that, in addition to these benefits, NWSGs provide important economic value to beef and dairy producers as a hedge against financial risks posed by overreliance on cool-season grasses.

Introduction

Endophyte infected tall fescue (TF) [*Schedonorus arundinaceus* (Schreb.) Dumort., nom. cons..] is the primary forage grown, accounting for over 5.7 million hectares in Mid-South U.S. (Keyser et al. 2011; Backus et al. 2017) and approximately 14.97 million hectares nationwide (Boyer and Keyser 2020). Tall Fescue (TF) is a perennial cool-season grass that grows well between April to June and October to November and is well adapted to the Southeastern U.S. (Fribourg et al. 2009). During summer, however, tall fescue forage decreases in quantity and quality and develops endophyte toxicity which reduces reproductive success, calving rates, milk production and weight gain in cattle (Roberts and Andrea 2004, Smith et al. 2012; Brazil et al. 2022) and results in billions of dollars in losses to the cattle industry annually (Strickland et al. 2011; Kallenbach 2015).

Incorporating NWSGs into a forage system can mitigate many of these problems (Tracy et al. 2010; Burns & Fisher, 2013; Keyser et al. 2016; Backus et al. 2017). Indiangrass (IG) [*Sorghastrum nutans* (L.) Nash], switchgrass (SG) [*Panicum virgatum* L.], big bluestem (BB) [*Andropogon gerardii* Vitman], little bluestem (LB) [*Schizachyrium scoparium* (Michx.) Nash], and eastern gamagrass (EG) [*Tripsacum dactyloides* (L.) L.] are perennial C_4 grasses native to the region. As such, they are well adapted to the ecology of the Southeastern United States, are resilient in the face of extreme weather events such as drought and floods, provide high yields of quality forage and have been well documented to provide critical habitat for at-risk grassland fauna including bird population and pollinators (Keyser 2022).

The issue/goals

To encourage wide adoption of NWSG forages, difficulties in establishing NWSGs must be addressed and ensure that they can be profitable to producers or at least do not reduce farm operator's income. In this paper, we focus on the economic/business side of these issues.

Studies have shown that profitability within beef and dairy cattle operations are strongly influenced by pasture and hay feeding cost (Keyser et al. 2016; Lowe et al. 2016). This paper provides a review of studies conducted for NWSG forages.

Studies that focus on economics of NWSGs have typically compared outcomes among different warm-season species, annual versus perennial, native versus non-native, and their performance within a specified scenario, such as fertilization regimes or various harvest treatments (Waramit et al. 2012; Boyer

et al. 2015; Lowe et al. 2016; Rushing et al. 2020; 2021). However, simple comparative studies between NWSG and TF during summer are limited. Regardless, both C_3 and C_4 forages should be included for this region's forage systems. Therefore, this paper focuses on economics of NWSG as a summer forage within a complementary system, one that includes a C_3 component, TF.

Discussion Weight Gains, Costs and Profitability of NWSG

Weight Gain

In a study that compared animals grazing an annual warm-season grass (AWSG), sorghum (*Sorghum bicolor* (L.) Moench) x sudangrass (*Sorghum bicolor* (L.) Moench ssp. *drummondii* (Nees ex Steud.) de Wet & Harlan) (SUDEX). The AWSG produced greater average daily gain (ADG) than endophyte-infected tall fescue during summer (Aldrich et al. 1990). Burns et al. (1984) compared steer performance when grazing SG to the sequential grazing of TF and bermudagrass (BG) (*Cynodon dactylon* L.), starting June 1st in North Carolina and found the ADG for steers grazing SG during summer was 66% higher than steers grazing the sequence of TF and BG. They noted that steers grazing SG yielded 322 kg/ha before the BG pasture was available to graze and concluded that both SG and BG could be an effective summer forage options in this region.

More recent studies by Keyser et al. (2022) compared weight gain for steers grazing SG, EG, BB, a mixture (BB/IG), BG, and crabgrass (CG) (*Digitaria sanguinalis* (L.) Scop.) in Tennessee and reported ADG of BB/IG (0.62 kg/day) was higher than the other forages, but the total grazing days were the greatest for EG and SG. Total gains for BB/IG, BG, CG, EG, and SG were 259, 186, 200, 276, and 315 kg per hectare, respectively, and gains per ha were greater (P <0.001) for all the NWSG than BG and CG.

Cost advantages

For NWSGs to make economic sense, their production should either minimize cost to producer or increase producers' profits. In the study by Tracy et al. (2010), the cost of production for grazing AWSGs was greater than that of NWSGs due to recurring cost of establishing AWSGs and concluded that NWSGs had a lower cost of production in the long run compared to AWSGs. These results were similar to previous studies which concluded that in terms of costs reduction over time, AWSG provided little to no economic advantage over NWSG (Comerford et al. 2005; Basweti et al. 2009).

In a study by Lowe et al. (2016), cost of gain from grazing bred heifers with BBIG, SG, BBIG inter-seeded with legumes, and SG inter-seeded with legumes found that the cost per animal per day was lower for grazing SG than BBIG, and the cost of grazing BBIG per animal per day was lower than the cost of including legumes with either SG or BBIG. The cost of grazing NWSGs compared to using harvested feed was lower than the equivalent feed rations at all yardage fees and did not compromise the necessary nutrition to meet ADG recommendations for growing heifers. Similarly, Lowe et al. (2015) compared expected net returns (ENR) of grazing beef steers over summer on a BBIG mixture and SG or selling those steers in May and found that ENR for both forages was always profitable (P<0.05), This study also shows that greater beef yield through grazing SG provided higher revenue than grazing BBIG.

Expected partial net returns (EPNR) across WSG were compared by Boyer et al. (2020), by grazing beef stocker cattle on BBIG, SG, EG, BG and CG and reported that SG had the highest EPNR ($430 ha^{-1}) while CG had the lowest EPNR ($3 ha^{-1}). In comparison, EPNR from grazing CG and BG were not different from each other but were lower than grazing other forages ($p < 0.05$).

A recent study conducted by Brazil et al (2022) compared profitability of three forage systems (100% TF, 70% TF with 30% BG, and 70% TF with 30% SG) using a simulation model for spring- and fall-calving herds. The study found that profitability in both spring and fall calving herds increased by incorporating

SG into TF forage system by \$877 ha^{-1}, while adding BG increased profitability only for spring calving herds by \$372 ha^{-1} when compared to grazing 100% TF.

Although SG seems to be the most studied and profitable in the majority of the studies, Monroe et al. (2017), compared ADG and revenue from other NWSGs including IG, a mixture of IG, BB, and LB, with performance from introduced forages', and found (primarily BG) that the NWSGs consistently had higher ADG and revenue. These results are similar to what Keyser et al. (2012) found when comparing cost of hay production using BBIG, BG and an AWSG. The study found that the NWSG were more profitable than BG or the AWSG, in part due to reduced nitrogen requirements. Consequently, break-even cost of hay production, cost of gain, and the number of years required to pay off the investments were more favorable with the NWSG.

Conclusion

The current literature shows that incorporating NWSGs within a grazing system in the fescue belt region will not lead to reduced farm income and can provide positive returns. Over the long run, NWSGs profitability may be even greater compared to TF and a TF/BG system. In most studies conducted so far, the results have shown that the probability of having positive revenue and long-term cost reduction is likely to increase with NWSG incorporated in a grazing system. However, there is still work to be done to ascertain the economic incentives of using NWSGs, especially in relation to TF in the fescue belt in the summer months, the long run comparison of the two systems and to determine the proportion of a forage base that should be converted to NWSGs for this complementarity to provide the greatest profits and optimal animal performance.

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