

CHAPTER I

INTRODUCTION

Agriculture is still a large part of the American landscape with 1.9 million U.S. farms reported in 1997 (USDA, 2003). These farms are diverse in size, operations, products, technology, and finances. Beef production is important on many of these farms to supply the large U.S. and growing international demand for beef products. In 2000, Americans consumed 29.2 kg of beef per person (USDA, 2003). As environmental and economic concerns increase, farmers must improve efficiency of their cattle operations. One of the best ways to achieve this goal is by reducing overall cattle maintenance costs and lowering feed costs (Hoveland, 1986). Forage crops provide low cost, high quality feed, especially when grazed. Farmers have commonly used forages as the primary feed source for cow-calf production, but the use of forages in stocker and finishing systems is increasing (Allen et al., 1996). To further increase forage utilization by stockers there is a need for high quality, low cost forage systems.

Historically, pastures and hay fields have primarily contained N-fertilized grass (Hoveland, 1986). Research has shown that legume-grass mixtures have numerous advantages over grass alone for beef production. Alfalfa and tall fescue both possess a range of desirable forage characteristics and combining these two species provides a productive, high quality forage mixture.

Tall fescue (*Festuca arundinacea* Schreb.) is grown on over one million acres in Virginia and on over 35 million acres in the United States, making it one of the most important cool season grasses in the United States (Ball et al., 2003). Tall fescue originated in Europe and was later introduced into North and South America (Buckner et al., 1979). It is a cool season perennial grass that is high in digestibility and well adapted to many areas. Tall fescue has good spring and autumn production with growth lasting into early winter, but summer production is usually low in the southeastern USA. This grass is commonly infected with the endophytic fungus *Neotyphodium coenophialum*, which provides a symbiotic benefit to the plant, but produces ergot alkaloids that can reduce livestock performance and cause toxicity symptoms (Ball et al., 2002). Fortunately, the development of stress-tolerant endophyte-free tall fescue cultivars along with proper management has reduced the incidence of animal disorders. Recently released non-toxic endophyte-infected cultivars (no ergot alkaloid production) should further increase the use and value of tall fescue as a forage.

Alfalfa is the most widely planted hay crop within the United States with 24 million acres in hay production (Natl. Agric. Stat. Serv., 2001). Alfalfa first originated in Iran and central Asia and is commonly cited as the first cultivated forage species with written accounts dating back 3300 years (Michaud et al., 1988). It is widely adapted to many areas, a good source of N fixation, and provides a high quality feed for livestock (Barnes et al., 1988). Alfalfa can provide additional growth in the warmer summer months when tall fescue production is low (Smith et al., 1992). This perennial legume has a deep taproot and good heat tolerance, which allows it to keep producing high quality forage during periods of drought.

Introducing alfalfa into tall fescue stands would combine two high yielding, persistent cool season forages to create an ideal mixture. Chamblee and Collins (1988) reported alfalfa in mixture with tall fescue can provide about 202-303 kg N ha⁻¹ to tall fescue. When alfalfa is added to a grass pasture forage intake increases, leading to greater livestock gains (Popp et al., 2000). Productivity, quality, and seasonal distribution are all improved when alfalfa is included in a mixed stand.

Unfortunately, tall fescue often out competes alfalfa when the two are planted in mixed stands. Studies have shown that the vigorous growth of tall fescue will reduce the amount of alfalfa in a mixture, reducing the nutritive value of the mixture (Smith et al., 1992). The seasonal growth pattern of tall fescue allows it to have vigorous tillering and crown expansion in early spring and late autumn, allowing it to shade the alfalfa plants. Grazing-tolerant alfalfa cultivars have been developed which show increased persistence in pastures, but these cultivars still have reduced survival when mixed with grasses (Smith et al., 1992). Newer grazing alfalfa cultivars have been released in the last two years, but there have been few studies to test the abilities of these cultivars to compete with grasses in a mixture (Katepa-Mupondwa et al., 2002).

Stand management is the most important factor in creating and maintaining any grass-legume mixture. There have been several studies on the overall management of grass-legume mixtures especially for hay production, but fewer studies on the detailed management of mixtures for grazing. Past alfalfa-tall fescue mixture research has included the effects of seeding rate and method, fertilization, stockpiling, cultivar testing under continuous grazing, and the effects of clipping on yield and botanical composition. The detailed management of alfalfa-tall fescue mixtures for grazing, especially rotational,

has been ignored in past studies. Farmers in the U.S. and Virginia would greatly benefit from being able to add alfalfa to their tall fescue stands and maintain alfalfa in the mixture, but management recommendations are needed.

The development of management recommendations for alfalfa-tall fescue mixtures was a major focus of this research project. The effects of defoliation height and frequency on botanical composition and persistence of alfalfa-tall fescue pastures were tested. Cultivar choice is important in the success of any alfalfa-grass mixture, therefore twenty alfalfa cultivars were seeded with tall fescue to test their persistence with this vigorous grass. Another main goal of this study was to compare livestock performance, forage quality, and productivity of alfalfa-endophyte-free tall fescue mixtures to N-fertilized endophyte-free tall fescue pastures. The research project was developed to study the advantages and limitations of alfalfa-tall fescue mixtures, and find the management practices that are most suitable for this promising mixture.