SS AGR 297

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Production of Biofuel Crops in Florida: Elephantgrass[1]

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Introduction

Elephantgrass (*Pennisetum purpureum*) was first introduced into the United States from Africa in 1913. Prior to 1960, research in Florida focused on elephantgrass as potential forage for cattle. A new research initiative emerged following the oil embargo of 1973. In the 1980s, funding for renewable energy became available through an agreement between the University of Florida's Institute for Food and Agricultural Sciences and the Gas Research Institute of Chicago, Illinois. A major objective was to identify herbaceous plants with the highest biomass yield. Early on it became clear that elephantgrass was a premier biomass plant. After 15 years of field trials conducted in Florida, as well as trials in southern Alabama and Georgia, five of the best elephantgrass selections for biomass energy were planted in a holding nursery in 2000 at the Plant Science Research and Education Unit near Citra, FL by Dr. Gordon M. Prine. The nursery included Merkeron, N51, N43, N13, and PI 300086 elephantgrasses. Merkeron, N51, N43, and N13 yielded well throughout Florida and have the potential to grow as perennials in the lower southeastern USA. Selection PI 300086 is high yielding, but stands can be reduced by the more severe winters in North Florida. For cold tolerant selections, the northern limit for sustained survival and adequate yield is the plant hardiness zone where temperatures do not drop below 15 to 20°F or -6.7 to -9.4°C.

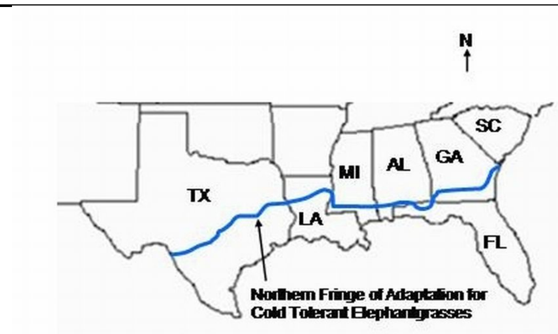

Figure 1. Northern limit of *Pennisetum purpureum* for sustained production in the southeastern USA Credits: Woodard, K. Agronomy Department UF/IFAS.

Current Potential for Use as Biofuel

In the 1980s, energy conversion strategies included the use of elephantgrass as a feedstock for methane generation or co-firing it with coal to produce electricity. Currently, there is widespread interest in the production of cellulosic ethanol. The feasibility of producing ethanol from cellulosic crops such as elephantgrass has greatly improved in recent

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times due to a number of factors: there have been improvements in fermentation strains and in methods for generating sugars from cellulosic feedstocks; the cost of enzymes used to break down cellulose has been reduced dramatically. In addition, economic incentives for cellulosic ethanol production exist due to high oil prices and the resulting increase in governmental support programs for renewable energy enterprises.

Figure 2. Full season growth of Elephantgrass near Gainesville, FL. Credits: Forage Extension, Agronomy Department, UF/IFAS.

Biology of Elephantgrass

Elephantgrass is an erect, perennial bunchgrass with large stiff stems at maturity. Although dwarf and intermediate strains exist, tall-growing selections produce the highest biomass yield when allowed to grow the entire warm growing season. From April through October, the coarse stems increase in length and weight, accumulating dry matter up to 18 feet above the ground. Spike (cattail) seed heads emerge from late October through November for most selections. Seeds are small, quickly lose viability, and are genetically diverse; therefore elephantgrass is propagated vegetatively.

Production

While the highest production has been reported on moderately-drained, lowland soils, elephantgrass is drought tolerant and can produce high yields on excessively-drained, deep sands. Though clump sections can be dug and used for propagation, it is primarily propagated with 3- to 4- node (bud) pieces cut from the hardened portion of the stalk. Pieces planted horizontally in furrows should be covered with no more than 2 to 3 inches of soil. Three-node stalk pieces can also be placed into the soil at a 45 degree angle with the uppermost node exposed. To produce quality planting material, nurseries should be fertilized in the spring with a minimum of 300 lb of N per acre. Phosphorus and potassium should be applied based on soil test. For northern Florida, stalk pieces can be planted in August or from late October until the first killing freeze. When planted in the summer, elephantgrass should be allowed to accumulate biomass without harvest throughout the remaining growing season to ensure winter survival. The planting time is less critical, though, for southern Florida. In both cases, the seedbed should be thoroughly prepared. and rows should be 3 to 5 feet apart. For large operations, machinery used to plant sugarcane stalk pieces can be adapted for elephantgrass. Both summer and fall plantings can be harvested for biomass during the following growing season.

Potential Yields

In north-central Florida, the highest dry biomass yields have exceeded 20 ton/acre/year. Average production for full-season elephantgrass should range from 14 to 18 ton/acre. Yield depends greatly on the amount and distribution of rainfall and fertilization rate. For full-season growth, elephantgrass should be fertilized with 200 to 300 lb of N per acre in the spring in two split applications. Elephantgrass can also be harvested twice yearly. Annual yield will generally be 10 to 20% lower with two harvests, but the biomass will be more easily converted to methane or ethanol. For two harvests per year, apply 150 lbs of N per acre in the spring and 150 lbs of N after the first harvest.

Production Challenges

Major production challenges are the initial expense of establishment and the high N rates needed to produce heavy biomass tonnage. The cost of

Estimated Production Costs

In 2003, the total variable cost to establish one acre of elephantgrass with hand labor was estimated to be $530 (see *Energy from Crops: Production and Management of Biomass/Energy Crops on Phosphatic Clay in Central Florida* at http://edis.ifas.ufl.edu/EH213). This estimate included a fertilization N rate of 200 lb/acre using ammonium nitrate. While a higher cost can be expected at the time of this writing, it should be noted that establishment costs can be amortized over the life of the stand. With established stands, major production costs include fertilization and harvesting.

Environmental Concerns

As with all crops that require N fertilization and are grown on Florida's sandy soils, nitrate leaching is an environmental concern. Also, elephantgrass is currently on the “do not plant” list for South Florida due to its potential for invasiveness, but it can currently be planted in Central and North Florida. Invasive potential among improved elephantgrasses in North Florida has not yet been observed, but this issue requires further study.

Summary

Elephantgrass is the highest yielding, best adapted perennial grass for biomass production in Florida. Currently, however, there are no commercial facilities converting elephantgrass to bioenergy, so planting for bioenergy purposes cannot be recommended.

Sources of Additional Information

- Biomass co-firing with coal at Lakeland, Florida, utilities http://trees.ifas.ufl.edu/BioEnergy98%20Paper.pdf

- New Forage, Grain, and Energy Crops for Humid Lower South, US http://www.hort.purdue.edu/newcrop/proceedings1999/v4-060.html

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