U.S. Department of Agriculture
Work Unit Description AD-416
U.S. Dept. of Agriculture, State Agricultural Experiment Stations and Other Institutions

Date (Month/Day/Year): 12/21/2011

1. Accession No.	Agency Identifiers		5. Work Unit/Project No.	6. Status
	2. NIFA	3. LA.B	LAB94130	A = New Project

7. Title
Production potential and ecological impacts of agroforests and forest plantations managed for biofuel feedstock production

8. Performing Organization 0761 - 2010
Hill Farm Research Station
Agricultural Experiment Sta, Louisiana State Univ

9. Cooperating Departments within State Performing Institution
a. Northeast Research Station
b. School of Plant, Environmental, and Soil Sciences

10. Multistate Project No.

11. Cooperating States
AR Arkansas

POSTED

12. Investigator Name(s) Last Name and Intitials)

1. Blazier, M.A. 2. Alison, W.M. 3. Wang, J.J. 4. Liechty, H.O. 5. Pelkki, M. 6. West, C. 7. Tappe, P. 8. Brye, K. 9. Schuler, J.

13. Project Contact
Last Name and Intitials: Blazier, M. A.

Phone: 318-927-2578 |x 204
Fax: 318-927-2578

E-Mail: mblazier@agcenter.lsu.edu
URL:

Sent via BITNET/INTERNET electronic mail systems
Date: 12/23/11

14. Project Type	15. Contract/Grant/Agreement No.	16. Amount	17. FY
Hatch			

18. Award Date (Month/Day/Year)	19. Start Date (Month/Day/Year)	20. Termination Date (Month/Day/Year)
	01/01/2012	12/31/2016

Goals/Objectives/Expected Outputs

1. Determine biomass yields and their relationships with plant-soil carbon and nitrogen pools in agroforests comprised of mixtures of loblolly pine (Pinus taeda L.) and switchgrass (Panicum virgatum L.), in Northwest Louisiana that differ in: (1) Tree age (juvenile, mid-rotation, late rotation), (2) Tree stocking density (low, high), and (3) stand composition (switchgrass only, pine only, switchgrass and pine). 2. Quantify biomass production and potential bioenergy yields of agroforest systems comprised of cottonwood (Populus deltoids L.) managed as a short-rotation energy crop and switchgrass managed as a dedicated energy crop. 3. Quantify ecosystem services (carbon sequestration, nitrogen retention, wildlife habitat, and biodiversity) provided by cottonwood, loblolly pine, and switchgrass managed singly and combined in agroforestry systems.

Methods

In a trial of switchgrass grown between rows of loblolly pine, switchgrass growth, development, and nutrition will be determined each fall for five years, when switchgrass is at its peak biomass. Ground coverage will be determined by noting the presence or absence of switchgrass within a 0.09-m2 quadrat. Switchgrass biomass will be sampled within a 1-m2 quadrat at 14 random locations within the central alleys of each plot. Nutrient concentrations will be determined from subsamples of these switchgrass biomass samples to determine switchgrass nutrient accumulation. Nitrogen in the samples will be analyzed by Dumas dry combustion with thermal conductivity detection using a Leco FP-428 nitrogen/protein analyzer (Leco Corporation, St. Joseph, MI). All other nutrients in the samples will be determined by nitric acid digestion followed by analysis with ICP spectrometry. At the end of each growing season, stem dbh or groundline diameter and total height of every live tree will be measured. To determine nutrient accumulation of loblolly pine, foliar samples will be extracted from the upper-mid section of tree crowns from three dominant trees per plot. Foliage samples will be composited, and nutrient concentrations will be determined as described above for switchgrass. Several soil parameters will be measured to determine soil C and microbial function. Soil respiration will be measured each fall using the method developed by the Soil Quality Institute (1999). Soil samples for determination of soil labile C, microbial biomass C (Cmic), and microbial activity will be collected in the uppermost 15 cm of soil using a 2.5-cm diameter punch auger concurrently with soil respiration measurement. In a trial of switchgrass grown within alleys between alleys of cottonwood, a total of 90 trees/plot (30/clone) have been selected for annual measurements at each site. Switchgrass stand counts (basal ground cover by the base of the plant, or crown) will be performed twice yearly; in spring when there is 15-20 cm of new growth, and fall after biomass has been

removed. Belowground biomass samples will be collected in winter to a depth of 30 cm at age 3 and to a depth of 60 or 150 cm at age 5. The impact of different cropping systems and vegetation species on C accumulation will be determined in three ways: (1) the amount of C in the surface soil (30 cm depth) five years following the study initiation will be compared with that prior to switchgrass or cottonwood establishment, (2) soil C contents of the soils to a depth of 150 cm five years after treatment establishment will be compared among treatments (S, W, and C) and (3) soil carbon contents (60 cm depth) along the cottonwood-switchgrass borders five years after establishment. Microbial biomass C (Cmic) and activity will be measured quarterly in 2012 through 2015 to determine the influences of mature switchgrass and cottonwood, as well as harvesting of switchgrass and cottonwood on soil quality.

23. Non-Technical Summary

Global environmental and economic concerns about fossil fuel consumption have prompted interest in producing alternative fuels from renewable materials. Growing crops dedicated as energy feedstocks could increase biofuel production capacity with relatively minimal adverse environmental impacts. Highly productive energy crops can minimize land area requirements, agricultural chemical use, and hauling relative to conventional agriculture. Switchgrass has been identified by the U.S. Department of Energy as a model energy crop species after a comprehensive evaluation of potential feedstocks because of its biomass growth and energy yield potential. Agroforestry management practices may enhance the economic and ecological feasibility of producing switchgrass. Managing multiple crops as part of agroforestry management enhances farm success by increasing cash flow and reducing risks. Agroforestry systems are among the most productive and environmentally beneficial agricultural systems. Switchgrass has been shown to establish and grow more favorably under shade of longleaf pine than in open sunlight in natural ecosystems of the southeastern U.S. As such, switchgrass may have a high potential for incorporation into an alley cropping system, in which switchgrass is managed as an annually harvested crop within alleys between trees, with the more economically significant and prevalent loblolly pine of the region. It may also be possible to integrate switchgrass with cottonwood within the Lower Mississippi Alluvial Valley (LMAV). The LMAV has a high potential for bioenergy crop production because of its long growing season and well-developed agricultural infrastructure. Similar to switchgrass, the U.S. Department of Energy identified cottonwood as a model energy crop species. Eastern cottonwood is one of the fastest-growing native trees in the southern portion of the U.S. and attains its highest growth rates on wet soils in the Mississippi Valley. There are deficiencies in our knowledge of the yields of switchgrass, loblolly pine, and cottonwood when integrated into alley cropping agroforestry systems and in the soil nutrition and stand conditions that govern yields in such systems. There is also a lack of understanding of the relative influences of switchgrass, loblolly pine, and cottonwood on key soil indicators of sustainability, soil nutrition, carbon sequestration, carbon losses, and wildlife habitat quality. To develop economically and ecologically viable production systems for the alternative fuel crops, it is essential to better understand these factors. Two trials for exploring these issues (one in which switchgrass is established and managed in loblolly pine alleys, and one in which switchgrass is established and managed in cottonwood alleys) are integrated in this proposal due to their similarities in objectives. Together, the trials pursued in this proposal have the potential to develop alley cropping systems for switchgrass that can be suitable either for the abundant southern pine forestlands or alluvial agricultural lands of Louisiana and other states of the southeastern U.S.

24. Keywords

switchgrass, biofuel, carbon

****** The Original signed document is on file at this institution. ******

Signature	Title	Date
Dept: Admin: David H. Newman	*Associate Director*	12-21-11