The Status and Future of USDA Forestry Research in the Great Plains[1]

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Abstract.-- The number of USDA field units active engaged in tree-related research in the Great Plains has declined from nine to two in recent years, and funding is flat. Despite this decline in overall effort, the USDA Forest Service Unit in Lincoln, Nebraska is developing a novel research program of research on improvement of tree stress and pest resistance. In addition, a research and development initiative is being developed that will emphasize agroforestry systems that integrate tree windbreaks with conservation farming practices.

INTRODUCTION AND HISTORY

Before discussing the future involvement of the U.S. Department of Agriculture in Great Plains forestry research, it would be appropriate to briefly review its past involvement. Historically, the Forest Service and the Agricultural Research Service have played important and productive roles in researching and solving problems related to Great Plains forestry. The Soil Conservation Service has contributed significantly through the formulation of tree establishment and management guidelines, and the establishment of regional Plant Materials Centers. Great Plains land grant universities have made important contributions in conducting forestry research, establishing demonstration studies, and disseminating research results through their extension divisions. Several bibliographies and state-of-the art reviews have been compiled on Great Plains forestry and windbreak technologies (Alcorn and Dodd 1984; Brandle, Hintz, and Sturrock 1988; Campbell and Pratt 1974; Cunningham 1982; Loucks 1983; Read 1961).

USDA research installations devoted primarily to Plains forestry and related subjects in the Great Plains have been located at Bottineau, Mandan, and Denbigh, ND; Sidney, MT; Cheyenne, WY; Akron, CO; Lincoln, NE; Manhattan, KS; and Woodward, OK.

THE PRESENT

In contrast to the past, the number of Agricultural Research stations and Forest Service field units currently engaged in tree related research in the Great Plains has declined to two (Mandan, ND and Lincoln, NE, respectively) in recent years. Agricultural Research Stations adjacent to the Great Plains, which may have researched tree problems in the past, now emphasize research on grasses, agronomic crops, fruit trees, soil erosion, and other subject areas indirectly related to Plains forestry. Examples are the Northern Plains Soil and Water Conservation Laboratory at Sidney, MT, and the Wind Erosion Laboratory at Manhattan, KS. The Forest Service Shelterbelt Laboratory at Bottineau, ND, and the Wildlife Project at Lubbock, TX, were closed in 1982.

The research project: "Genetic Improvement of Trees for Soil and Water Conservation" at Mandan, ND, is the sole ARS project directly engaged in tree research in the Great Plains. This project has 1.3 scientist years assigned to tree-related research. Forest Service research relating directly to Great Plains forestry is centered solely at Lincoln. NE, and is staffed by five scientists. Thus there are presently only 6.3 USDA scientist years being devoted directly to forestry research in the Great Plains--a region containing one-fourth of the land area of the contiguous United States.

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THE FUTURE

Despite the decline in USDA Plains forestry research, the possibilities for future scientific contributions to Plains forestry seem bright. A solid foundation of research knowledge has been laid. Procedures have been developed for procuring sound seed; raising quality nursery stock; growing containerized tree seedlings; designing, establishing and managing windbreaks and other plantings; controlling disease pathogens and insect pests; developing genetically improved strains of tree seed; and determining physiological, ecological and soils relationships to tree performance.

Now, Plains forestry research is entering a new and exciting era, with new tools available for research at the molecular, process, and whole plant levels. The probability for productive research is high indeed, with the availability of new computer technology and sophisticated research instrumentation, and a cadre of young, well-trained scientists in a variety of forestry-related disciplines. Cunningham (1984) cited packaging of clonal mixtures of hardwood species; research in tree survival, cold hardiness, and drought hardiness; adaptability to problem soils; and selection and breeding for faster growth and more desirable form characteristics as future tree improvement research possibilities. Cunningham further pointed to biotechnology playing a significant role in the future of Plains forestry.

Concurrent with the new era of research at the process and molecular levels, there will be a need to continue and complete previously begun long-term studies of a more applied nature. Cunningham (1984), for example, cited the need to continue traditional tree improvement research consisting of provenance testing of newly introduced species, followed by selection, clonal and full-sib progeny testing, and seed orchard establishment. Continuing research in soils, genetics, entomology, pathology, and windbreak establishment, management, and renovation should not be abandoned, but rather, should supplement and complement more basic research in these allied fields.

The prognosis for increases in USDA funding for Plains forestry research appears bleak for the foreseeable future. In FY 1988, the Rocky Mountain Station had the smallest percentage budget increase of all Forest Service Experiment Stations in the U.S.; and the Station's budget has been the smallest of all Station budgets for some years. The Station was larger in terms of people and funding 10 years ago than at present. Conversely, the Station has produced more research publications per scientist during the past three years than any other Forest Service Research Station in the United States. In fact, the Rocky Mountain Station produced more research publications last year than during any other year in its 50-plus year history. We conclude that the Rocky Mountain Station, of which the Lincoln field unit is a part, is productive, but not as competitive as we need to be.

SOME FOOD FOR THOUGHT

With 75 years[3] of Great Plains forestry research experience behind us, it is appropriate that we take time to reassess our situation. Following are several key points affecting and characterizing the direction of Great Plains forestry research:

1. The Great Plains is predominantly a semiarid food-producing region. There are few forests in the Great Plains. Most trees planted in the Great Plains are in cities, or in farmstead and field windbreaks where they must serve a specific purpose.

2. The Great Plains is characterized by environmental extremes and periodic droughts, and is threatened by predicted global climate changes. The trees we plant must have adequate stress and pest resistance to withstand present and future environments.

3. Great Plains agriculture is experiencing some stress of its own from: a) low farm income and high subsidies, b) growing public concern with agri-chemical pollution and food contamination, c) periodic droughts and water shortages, d) topsoil loss, e) surface and groundwater contamination, and f) lack of sustainability of present high-input farming systems. A crisis situation is building, but it's not readily apparent to everyone, as was the dust bowl.

4. The Great Plains holds 71.5 percent of U.S. cropland where wind erosion is greater than the soil loss tolerance of 5 tons/acre/year (USDA 1987), yet only 3.5 percent of this land is protected by windbreaks. The present 1 million acres % windbreaks produce $700 million/year[4] in benefits (Rietveld 1989, unpublished data). Two-thirds of these windbreaks are aging and in need of renovation (Fewin and Helwig 1988). Unless cost-effective renovation techniques are developed and promoted, we expect the present net loss of windbreaks (0.4 percent /year) to escalate.

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[3]Agricultural Research Service shelterbelt research in Mandan, ND began in 1914; Forest Service windbreak research in Lincoln. NE began in 1953.

[4]Rietveld, 1989; estimated from available data. A subsequent publication will present details of estimating the value of windbreak benefits and an economic analysis of agroforestry in the Great Plains.

5. The Conservation Reserve Program (CRP) is a lost opportunity for Great Plains forestry (Deneke and Bratton, in press). As of the seventh signup, only 20,500 acres (0.13 percent) of the 16 million acres enrolled in CRP in the 10 Great Plains states were planted .to trees; 90 percent of the remaining acres were planted to grasses. Unfortunately, when the program expires in 10 years, most of these highly erodible lands can, and probably will, be plowed again.

6. Great Plains forestry lacks a clearly defined role in the national scene because of the lack of timber production and lack of understanding of the value of agroforestry. Consequently, federal funding for Great Plains tree-related research is declining.

7. The Great Plains region is representative of millions of acres of semiarid lands westwide and worldwide where tree planting for crop, animal, and road protection; soil and water conservation; water quality; biological diversity; recreation and wildlife benefits; environmental quality; and socio-economic benefits are more important and more valuable than timber production.

Considering these key factors, two main implications stand out: (1) there are enormous potential benefits from tree planting in the Great Plains, and (2) Great Plains forestry is languishing because of its low priority. Although we, as foresters, recognize that trees should be an integral part of the Great Plains ecosystem, we must also recognize that trees, like any other crop, must be economically justifiable in a predominantly agricultural community. Promoting tree planting from the standpoint that "trees are nice" will have moderate success, mostly in establishing urban and farmstead trees, but the real need is in establishing field windbreaks. In the fields, trees most definitely must: (1) have a definite purpose, (2) be suited to the task, and (3) be economically justifiable, or they simply won't be planted or won't be kept.

Our research, technology transfer, and education efforts in the Great Plains must go beyond "trees are nice" and "plant trees for protection". We must broaden our scope and develop and deliver complete, integrated, and fully tested agroforestry systems. Agroforestry, as applied to the semiarid Great Plains, is defined as: a sustainable land management system that synergistically integrates the wind erosion and crop protection of tree windbreaks with the water erosion protection of conservation farming practices, thereby fully protecting the soil resource, stabilizing and optimizing productivity, and providing additional amenities. Thus, in the Great Plains, the primary agroforestry benefits are from soil and crop protection; other benefits are secondary in comparative value, yet highly significant.

To accomplish such an undertaking, we need to develop partnerships with agricultural scientists. From a forestry research standpoint, an immediate need is to focus on developing trees especially suited for field windbreaks, and to develop appropriate agroforestry windbreak technologies. This is discussed further in the following sections.

In our present role as Great Plains foresters, we obviously have a lot to offer, but as evidenced by CRP, a lot of people are not listening. Why? We need to take a hard look at our identity, priority, acceptance, and future role in the Great Plains agricultural community. If we are to realize the fruits of our new research potential, we must become more politically astute and proactive in promoting the importance and value of Great Plains agroforestry and collectively competing for the available research dollars. And we must do it as intensively as we have cooperated in the past to solve important and difficult research problems.

PROGRAM REDIRECTION

Over its 36-year history, the Lincoln, NE field unit of the Rocky Mountain Station has produced a valuable foundation of research information on tree improvement, windbreak establishment and management, and pest biology and management. Technology transfer in the Great Plains will be enhanced with USFS State and Private Forestry establishing two new Forest Pest Management positions at Rapid City, SD and transferring its Great Plains Forestry Specialist to Lincoln. These factors, along with personnel changes at Lincoln, make program re-direction possible.

The new research emphasis at Lincoln will be to "Improve stress and pest resistance of Great Plains tree species." We feel that more emphasis needs to be placed on research that focuses on our basic understanding of the interactions of tree physiology and genetics, environmental stresses, and pest populations in order to achieve more ecologically sound, biologically acceptable, long-term solutions to Great Plains forestry problems. Our general hypothesis is: lack of adaptation and environmental stresses lower tree vigor, which predisposes them to pest attack. These pests cause further stresses, which result in tree decline and premature death. Our new interdisciplinary research will emphasize molecular genetics, stress physiology, pathology, and entomology. Specific objectives are to: (1) screen for intraspecific differences in tree stress and pest resistance, (2) understand tree vigor/pest/natural enemies/environment interactions, (3) develop tree adaptability models for the Great Plains, (4) understand mechanisms of tree stress and pest resistance, and (5) develop stress and pest resistant trees.

This research effort, under existing funding levels, is now possible because of the wealth of provenance tests established in the Great Plains that will provide a diversity of genetic materials, and the solid foundation of basic biological information on Great Plains species. Despite the emphasis on new science and technology, our focus will be highly applied. Our approach will be process-oriented so we understand the key interrelationships, but we will strictly adhere to the goal of producing more stress- and pest-resistant trees. We anticipate that this strategy will not only focus on the root causes of Great Plains forestry problems, but will also vastly improve our competitiveness for research dollars.

A GREAT PLAINS AGROFORESTRY INITIATIVE

We believe the real key to the success of Great Plains forestry is developing, packaging, delivering, and supporting complete, integrated, and sustainable agroforestry systems. Such an effort cannot be accomplished under current research funding levels. Thus, we have developed an initiative to establish a center for semiarid agroforestry research, development, and technical assistance at Lincoln, NE. The 20-year research, development, and demonstration program would develop economically and environmentally sound sustainable agroforestry systems, attain public acceptance of windbreak technologies and conservation farming practices, and improve the quality of life in semiarid environments. Our goal is to convert at least 12 million of the 48.2 million acres of highly wind-erodible lands in the Great Plains to agroforestry during the 20-year program.

The components of the agroforestry program include: (1) Forest Service research on improving tree resistance to stress and pests, as previously described; (2) Forest Service, Soil Conservation Service, and Agricultural Research Service interagency cooperative research and development on windbreak technologies, tree improvement, biological control of tree insect pests, economic evaluation, and social science; (3) supporting extramural research on related subjects by Great Plains universities; (4) agroforestry demonstration areas in Great Plains States in cooperation with state forestry agencies and agricultural experiment stations; (5) technical assistance on tree pest management by USDA Forest Service State and Private Forestry personnel co-located at the Center, working in cooperation with State forestry agencies, Agricultural Extension Agents, and Soil Conservation Service; (6) agroforestry technical assistance by the Soil Conservation Service, State forestry agencies, and Agricultural Extension Service; and (7) international exchange of agroforestry information by USDA international liaison personnel co-located at the Center.

Specific goals to be accomplished by the agroforestry center and its cooperators are: 1) develop sustainable agroforestry systems that will minimize topsoil loss and water contamination while maintaining crop productivity and farm income; 2) adapt, demonstrate, document, and model the effectiveness of agroforestry under different farming systems and soil/climate conditions; 3) develop genetically superior trees for windbreaks that will have improved stress and pest resistance and a longer effective lifespan; 4) increase farmer and public acceptance of sustainable agroforestry systems; and 5) increase biodiversity, wildlife habitat, recreation opportunities, and environmental quality.

An economic analysis of various program alternatives revealed that the 20-year program, in combination with existing cost-sharing programs, could convert 12 million acres of highly wind-erodible land to agroforestry with an average benefit:cost ratio of 1'70 and net present value (4 percent) of $10.88 billion. In combination with new cost-share and land rent incentives (e.g., 75 percent tree planting cost-share plus rent on land occupied by windbreaks during the tree establishment period), 24 million acres could be converted to agroforestry, with an average benefit:cost of 86 and net present value (4 percent) of $21.68 billion.

We have developed a prospectus for the Great Plains Agroforestry Center, and are in the process of contacting cooperators to enlist their support. We have been working closely with Senators James J. Exon (D-NE) and Robert Kerry (D-NE), and are developing strategies to include the Great Plains agroforestry program in legislation before the Congressional session beginning in Sept. 1989. If our efforts are successful, the establishment of the Great Plains Agroforestry Center and umbrella of cooperative programs would be a strong boost for everyone concerned with Great Plains forestry, and would clearly define the future direction of forestry in the Great Plains.

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