



Science from the Field to Your Shopping Cart

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Every issue of Forage Focus has articles contributed by scientists from the U.S. Department of Agriculture (USDA) who are part of the in-house research division known as the Agricultural Research Service (ARS). Most people know the U.S. government funds scientific research in such agencies as NASA and the National Institutes of Health, but not many people know the government also funds agricultural research. In fact, ARS may be one of the best-kept secrets in the federal government. Nonetheless, the research done by ARS affects everyone in the country every day of the year.

ARS research has gone into shopping cart. Besides the products like food and clothing, everyday items that you might

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practically every item in your traditional farming and ranching ARS research has brought you many not connect with agriculture, like

permanent press cotton and DEET mosquito repellents. To read more about the research and resulting products see the ARS publication *Science in Your Shopping Cart* (<http://www.ars.usda.gov/is/np/shopcart/shopcartintro.html>). Today, ARS has 2,100 scientists and 6,000 support personnel in over 90 locations throughout the U.S. Research is done in the areas of Nutrition, Food Safety, and Quality; Crop Production and Protection; Animal Production and Protection; and Natural Resources and Sustainable Agricultural Systems. In all, there are 800 projects organized in 17 national programs. Information on these projects is posted on the ARS website (www.ars.usda.gov). One of the best ways to read about ARS research is through the online *Agricultural Research* magazine. There is a link to the magazine on the ARS homepage.

Alfalfa research in ARS is currently being done in Minnesota (Saint Paul), Wisconsin (Madison, Prairie du Sac, Marshfield), Maryland (Beltsville), Utah (Logan), Washington (Prosser, Pullman), Illinois (Peoria), and Iowa (Ames). In total, 20 scientists are involved in alfalfa research. The research is coordinated nationally through the ARS National Program 215: Pasture, Forage and Rangeland Systems. Every 5 years the program holds a series of stakeholder workshops to identify research problems, develop action plans, and coordinate research among locations. Scientists at each location then develop 5-year research project plans with specific research objectives and annual milestones. The plans are reviewed by a panel of peer scientists external to ARS for adequacy of approach, probability of success, and merit of the research. In addition, the ARS personnel involved in alfalfa research developed a national roadmap for alfalfa research to coordinate current research and to guide future initiatives. The overall goal of the alfalfa roadmap is to expand the presence of alfalfa across the landscape by increasing yield, reducing labor requirements for harvest and storage, enhancing utilization by animals, developing new uses, and amplifying environmental services provided by alfalfa.

There is a long history of alfalfa improvement in ARS. In the 1970s and 1980s, ARS scientists were leaders in identifying microorganisms causing major alfalfa diseases, developing methods to select for resistant plants, and releasing disease resistant germplasm for use by the alfalfa seed industry. One example is development of the cultivar Agate, which was the first cultivar with resistance to *Phytophthora* root rot and the basis of industry varieties with improved disease resistance. Multi-pest resistance cultivars released during this period resulted in the largest gains in forage yield that have been achieved to date. Research also focused on novel traits such as the cultivar Nitro, the first legume variety selected for enhanced nitrogen fixation and assimilation, which can rapidly increase soil fertility. During the same period germplasm lacking the ability to fix nitrogen was discovered and released for use in remediating soil and wastewater with excess nitrogen. More recently, a high yielding biomass type alfalfa was developed with non-lodging stems, which has the potential to produce twice the ethanol than hay type alfalfa.

Currently, the greatest research emphasis in the ARS alfalfa program is in genetic improvement of alfalfa through the development and use of DNA markers associated with agronomic traits including disease resistance, drought tolerance, salinity tolerance, and for morphological traits such as the formation of rhizomes. ARS scientists developed DNA markers for each chromosome that enable plant breeders to identify the parents of plants with high performance for the traits of interest. Previously, breeders often did not know the identity of the male parent, hampering selection of the most useful elite plants for developing a cultivar. The recent rapid development of DNA markers is a result of sequencing the genome for *Medicago truncatula*, an annual medic closely related to alfalfa. The genome sequence provides numerous potential DNA markers and also is the basis for assembling the genome

sequence for alfalfa, which is more than double the size of the *M. truncatula* genome. In addition, the recent availability of rapid and inexpensive DNA sequencing methods has opened up new avenues for identifying DNA sequences associated with agronomic traits and for selecting elite parents for cultivar development. Not only are new tools being added to the breeder's toolbox to accelerate cultivar development, but these methods will help us understand the function of the genes and biochemical pathways underpinning the traits that we can see and measure.

ARS scientists are also hard at work developing novel harvesting and storage technologies to enhance alfalfa feed quality and develop new products. These harvesting methods have the advantage of reducing the number of harvests, reducing labor, increasing harvest flexibility, and increasing the functionality and value of the harvested forage. ARS scientists have been at the forefront of documenting the environmental and agronomic benefits of alfalfa cultivation. Current research focuses on developing and evaluating farming systems that strategically incorporate alfalfa on the landscape to reduce impacts of row crops and livestock agriculture. The contributions of ARS scientists to alfalfa research will guarantee that alfalfa producers have the knowledge and cultivars for 21st century farms and markets.

