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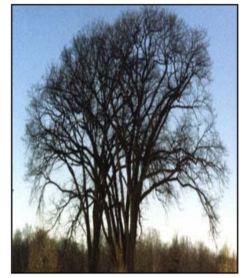

"Going to the woods is going home"
- John Muir

North Dakota's forests – a scattered look at what's where, and why

Joe Zeleznik, NDSU Extension Forester

When I tell people that I'm a forester in North Dakota, I get dazed looks and then the jokes begin. "Do you know what the state tree of North Dakota is? It's the telephone pole!" It goes downhill from there. Forests in North Dakota are few and far between. So are foresters. Nevertheless, the history of North Dakota's forests is highly varied and quite interesting. The state is unique because it is situated between the eastern forests and the western forests, with characteristic species of both regions. This article will discuss the variability of some of the state's forests and how they came to be what they are. Future articles will discuss the ancient forests of North Dakota and the current public forestland.

"Bright, clear sky over a plain so wide that the rim of the heavens cut down on it around the entire horizon . . . Could no living thing exist out here, in the empty, desolate, endless wastes of green and blue? . . . If life is to thrive and endure, it must at least have something to hide behind!"
O.E. Rolvaag
Giants in the Earth

When Lewis and Clark arrived – riparian forests

North Dakota is the least forested state in the country (as a percentage of total land area). The original forest covered about 700,000 acres, slightly more than 1.5 percent of the state (Jakes and Smith 1982). The reasons are fairly clear. The climate is characterized by very cold winters and very hot summers – usually. Precipitation is irregular, with only light-to-moderate amounts annually (Enz 2003). These characteristics, combined with high winds and regular wildfires, kept North Dakota mostly treeless. The native forests of North Dakota were, and still are found mainly along the rivers and streams of the state (Figure 1).

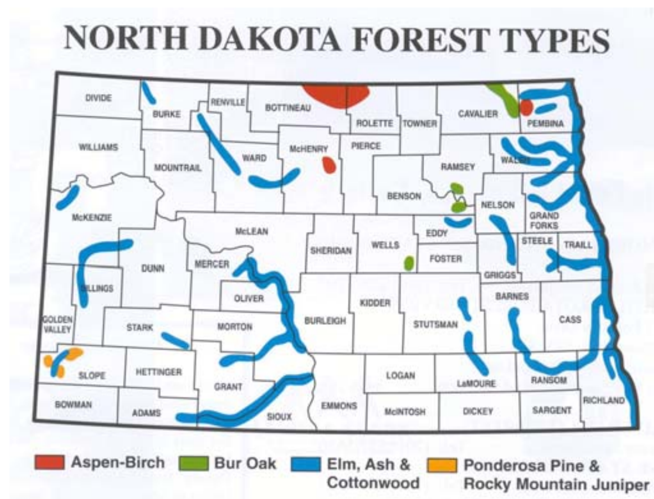

Figure 1. The native forests of North Dakota. Map courtesy of the N.D. Forest Service.

The riparian forests (those along rivers and streams) of western North Dakota were dominated by towering cottonwoods, with a component of green ash and American elm trees. In the eastern part of the state, green ash and American elm dominated. Minor components included boxelder, American linden, ironwood and the occasional bur oak farther from the water's edge. One of the more impressive sections of riparian forest still remaining is called Smith Grove (Worthington 1988). This area of land, 23.7 acres, is owned and managed by the N.D. Game and Fish Department. The Department bought it from George Smith in 1971. The Smith family never allowed livestock into the stand and didn't allow it to be burned. It contains some of the largest – and presumably oldest – cottonwood trees in the state (Figure 2). In 1988, Buck Worthington of the Soil Conservation Service estimated these trees to be 250 to 300 years old.

Figure 2. Barry Kiemele, city forester for Mandan, N.D., standing in front of a giant cottonwood tree in Smith Grove, summer 2004. Photo by Joe Zeleznik.

Smith Grove is close to the Lewis and Clark expedition campsites of October 24, 1804, and August 17, 1806. The grove was added to the American Forests' "National Register of Historic Trees" (Grondahl 2004). The Towner State Nursery, part of the N.D. Forest Service, collected seed from these trees in 2000 and began delivering them to the state's schools in 2002 as part of their Lewis and Clark Cottonwood program.

While many forests are susceptible to flooding, the cottonwoods actually require flooding to regenerate. Grondahl (2004) discussed some of the efforts by state and federal agencies and private conservation groups to restore cottonwood on specific sites. Most of these have been relatively small projects, but very little natural regeneration is occurring because of regulated water levels. A larger effort was made by the N.D. Game and Fish Department following flooding in 1996-97 on the Lewis and Clark Wildlife Management Area near Williston. Following flooding, these areas were allowed to regenerate naturally and the cottonwoods became established. However, as Grondahl notes in the article, "without some planning and foresight, the Missouri River bottoms could one day be a sea of brome grass and Russian olive."
For a more thorough discussion of the ecological changes affecting the entire Missouri River ecosystem, read "The Missouri River ecosystem: Exploring the prospects for recovery" (National Research Council 2002).

Non-riparian forests

Other locations, those that have excessively sandy soils or that are very hilly, also are dominated by forests. For example, forests dominated by bur oaks are found at Sully's Hill (south of Devils Lake), in the Pembina Gorge area of Cavalier County and in southeastern Wells County in an area known as "Hawk's Nest." The aspen-birch forests are found in the Turtle Mountains, in Pembina County, and in the sandhills of McHenry County. In the Badlands, Rocky Mountain juniper and ponderosa pine are the dominant tree species. Each of these forests is unique and continues to provide recreational opportunities, wildlife habitat and an occasional harvest of timber or fuelwood.

An important forest type not reflected in Figure 1 is the collection of "wooded draws" found throughout western North Dakota (Figure 3). Wooded draws grow where there is a little extra moisture in the soil, such as north- or east-facing slopes (Barker and Whitman 1989). Many tree and shrub species are found in them and the dominant species will vary by location. For example, just west of the Missouri River, the wooded draws tend to be dominated by deciduous species, such as green ash and quaking aspen. Toward the Badlands, the forest switches to a mixture of deciduous trees and Rocky Mountain juniper, then to mostly ponderosa pine and juniper. There are various combinations between the extremes.

Figure 3. A collection of wooded draws on north- and east-facing slopes in Mercer County, N.D. Photo by Joe Zeleznik.

Wooded draws comprise only 5 percent to7 percent of the total acreage in the badlands region of North Dakota (Hopkins 1983). As mentioned above, wooded draws are found mainly on north- and east-facing slopes where temperatures are cooler and there is enough moisture in the soil to maintain growth. Whether wooded draws are expanding or shrinking has been debated for at least 20 years (Fitzpatrick 2003). Nevertheless, fire definitely maintains the boundaries of these forest ecosystems.

In a study of the effects of fire on wooded draws, Fitzpatrick (2003) found that green ash regenerated quickly following fire and dominated the stand within 10 years. Most shrubs took 10 to 20 years to reach their maximum densities in green ash draws. Where Rocky Mountain juniper was the dominant species, fire killed a substantial number of trees. Areas burned more than 60 years prior to the study showed slow signs of recovery. Some juniper stands were eliminated by fire and had no saplings regenerating. The management implications are clear – fire should help in the regeneration of green ash stands, while it can be used to eliminate or at least limit the expansion of Rocky Mountain juniper draws.

Another interesting and unique native forest type found in North Dakota is the limber pines. It is found in western Slope County on land mostly owned by the U.S. Forest Service, but spreads onto some private lands. This stand is approximately 208 acres in size, though the limber pines themselves only cover about 30 acres (Heidel 1991). It was discovered in 1942 by Richard D. Williams of the Soil Conservation Service (Worthington 1975), but he didn't report it until 1949 (Stevens 1963) because he thought it was well-known to other scientists. Loren Potter and Duane Green (1964) studied this stand and found that the oldest trees were more than 238 years old. They are growing incredibly slowly. The largest tree was only 26 feet tall with an average diameter growth of about 0.10 inches per year. The Forest Service designated this area the Limber Pine Research Natural Area in 1991 (Ryan et al. 1994). These trees are an island of pine in a sea of prairie. The next nearest stand of limber pine is found near Terry, Montana (Dood 1980), which is approximately 80 miles to the west-northwest of the N.D. trees. The next closest beyond those are found more than 175 miles away in the Black Hills of South Dakota and in south-central Montana.

The origin of this stand has been debated for many years. One possibility is that there was once continuous forest from this point westward and as the forests receded and prairies expanded, these trees remained. Another possibility is that these trees were planted, intentionally or by accident, by Native Americans who used to come to this area to hunt (Potter and Green 1964, Beckes et al. 1982). The seeds of limber pine are edible and it is speculated that hunters planted some to provide a food source during future visits. Regardless of origin, this forest stand is unique. It is the lowest elevation natural stand of limber pine in the country (Steele 1990) and is a rarity in North Dakota.

South of Medora lies an area that contains black cottonwood (*Populus trichocarpa*), which is another species common to the western U.S. (Stevens 1963). This species is related to the native Plains cottonwood (*Populus deltoides* ssp. *monilifera*) and can form natural hybrids. Apparently this has occurred south of that location because a sample in the NDSU Herbarium was collected in 1951 in Slope County and labeled as *Populus* x. *acuminata*.

The Dakota National Forest?

On Nov. 24, 1908, President Theodore Roosevelt signed a proclamation establishing the Dakota National Forest located in the area of ponderosa pines in what is now Slope County. President Woodrow Wilson signed another proclamation on July 30, 1917, that ended the Forest's short life. The Dakota National Forest has an interesting history that was summarized by Green (1960). Most of what follows is from Green's work.

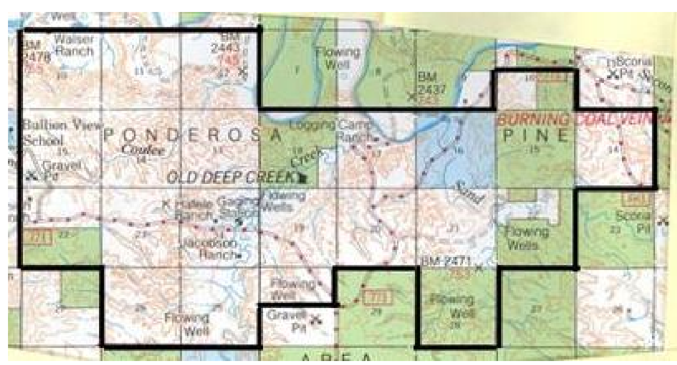

Figure 4. Map showing the boundaries of the Dakota National Forest (1908-1917), in what is now Slope County. Areas in green are part of the Little Missouri National Grassland, white areas are privately owned and the section in blue is state school land.

The first settlers to move to this region came in the 1880s. They established large ranches and grazed cattle and horses. Sometime in the late 1890s or early 1900s, A. C. Huidekoper, one of the owners of the HT Ranch, initiated a request that the area become a National Forest. The expectation was that the ranch would then be able to lease the government-owned acreage for grazing. The request was never acted upon.

A second request to establish a National Forest was sponsored by Governor Burke. On June 20, 1908, forest inspector Richard P. Imes submitted his official report on the potential of the area to become a National Forest. He reported favorably, but cautioned that this forest would be "considered a planting proposition" because there was "very little timber on the area." The goal for the Forest was to provide a combination of timber and grazing land for the region. Imes originally proposed that the Forest be called the Roosevelt National Forest.

The Forest Ranger was Ralph Sheriff, who arrived in the spring of 1910. He constructed a ranger station and began plans for establishing a nursery. In the spring of 1911, Sheriff and his assistant, Arthur F. Oppel, established the first seedbeds and sowed a crop of "western yellow pine," a.k.a. ponderosa pine. Another assistant, Kenneth D. Swan, supervised the transplanting of these seedlings into transplant beds in the spring of 1912. The Dakota was officially a "planting forest." Field planting also began in 1912. The initial stock that was field planted came from the Savenac Nursery in the Lolo National Forest of western Montana. It was believed that the seed came from the Black Hills of South Dakota.

Taking care of the trees in the nursery was just one of the duties of Mr. Sheriff. He also was in charge of issuing "free use" permits to homesteaders who would come to the Forest to harvest dead wood for kindling and fence posts. Digging coal for winter use was another important summer duty. However, seasoning the coal properly was tricky because it had to be dried slowly, out of the sun and wind, in order to burn satisfactorily.

The Ranger Station also served as a place for community gatherings. On the appointed date, neighbors would arrive from all directions at about dark. The dancing would begin and continue all night, with a light "lunch" just after midnight. In the morning, people would return home to another day's work in the hay fields. The Ranger Station also served as a post office (named "Ranger") for the area beginning in September 1912. Margaret Sheriff, the ranger's wife, served as postmistress. Service was sporadic until 1913 when a regular route was established between Ranger and Bowman three times a week.

Although the Forest and its personnel were integral parts of the community, the field planting operations on the forest were never very successful (Potter 1952). The area was isolated and was not used to any great extent. For these reasons and because of the "high cost of administration," the Dakota National Forest was abandoned in 1917. The land again was opened up to homesteaders.

Conclusion

Despite the limited amount of forest land in North Dakota, they are incredibly valuable and add diversity to the natural systems found in the state. Many things were not discussed in this article, but will be explored in future articles, including the effects of Dutch elm disease on the riparian forests of the state, the prehistoric forests of North Dakota, unique trees, such as the columnar junipers found near the Burning Coal Vein, or the largest and oldest trees in the state, as well as the many successful tree planting programs that have been conducted throughout the state's history. I urge you to visit and explore some of our native forests.

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Insect of the month – chokecherry midge

By Joe Zeleznik

The chokecherry midge (*Contarinia virginianiae*) is an elusive insect. Although it is a fairly common species, very little is known about it. In fact, I was unable to find any published reports in scientific journals or in major books that cover insect pests of trees. Only a few Extension Service publications in the U.S. cover the topic. There are some reports from the Canadian government. All the reports are similar.

Figure 1. Cluster of chokecherry fruits with two containing larvae of the chokecherry midge and one normal fruit. Photo by Joe Zeleznik

Chokecherry midge damage (Figure 1) appears in June and July as enlarged, pear-shaped fruits. The larvae are found inside the fruit (Figure 2) as orange maggots. They destroy the seed and leave the fruit hollow. The destroyed fruit often falls off before the normal fruits ripen. After the maggots have finished feeding inside the fruit, they drop to the ground to pupate during the winter. Adults emerge the following spring, probably around the time the chokecherries are blooming. They lay eggs in the flowers. Following the hatch, the larvae move into the developing fruit.

Figure 2. Larvae of the chokecherry midge appear as orange maggots. They will continue to feed until mid-summer, then drop to the ground to pupate and overwinter. The fruit will dry and fall before the normal fruit ripen. Photo by Joe Zeleznik.

Damage is usually minimal, although it can be quite substantial in certain situations. Several experiments were performed in the late 1990s by researchers at the Prairie Farm Rehabilitation Administration (PFRA) in Indian Head, Saskatchewan.

They treated chokecherry shrubs with several different insecticides (Table 1), which were applied at different times (before flowering, during flowering and after flowering). The insecticides mostly provided no control, except for one product (deltamethrin) at one site (Glenavon) in one year (1999). Based on the consistently poor performance of the chemicals, no insecticides are registered for chokecherry midge control. All the references suggest that destroying the fruit, before the larvae leave, is probably the best method of control.

Table 1. Various insecticides tested for control of the chokecherry midge (*Contarinia virginianiae*) in Saskatchewan, Canada. One chemical showed effective insect control, during only one year at only one site. Data organized alphabetically by insecticide name. Data from Agriculture Canada.

Insecticide name and concentration	Site	Year	Control
acephate 75%	Indian Head	1999	No
acephate 75%	Glenavon	1999	No
carbaryl 48%	Indian Head	1998	No
carbaryl 48%	Glenavon	1998	No
cyhalothrin-lambda 12%	Indian Head	1998	No
cyhalothrin-lambda 12%	Glenavon	1998	No
deltamethrin 5%	Indian Head	1997	No
deltamethrin 5%	Indian Head	1998	No
deltamethrin 5%	Glenavon	1998	No
deltamethrin 5%	Indian Head	1999	No
deltamethrin 5%	Glenavon	1999	Yes
diazinon 56%	Indian Head	1997	No
malathion 50%	Indian Head	1997	No
spinosad	Indian Head	1999	No
spinosad	Glenavon	1999	No

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Oak leaf blister

By Michael Kangas, Forest Health Specialist
North Dakota Forest Service

Spring moisture conditions play an important role in the occurrence of many foliar diseases. Several regions of North Dakota have seen an increase of such diseases during the past few years because above average spring moisture has been favorable to for disease development. Some of the commonly encountered diseases include ash anthracnose, Septoria leaf spot, and several powdery mildews. Oak leaf blister is less familiar to most people, but has been common in recent years.

Oak leaf blister is found around the globe on nearly 50 species in the red and white oak groups. The disease occurs throughout the Great Plains, but tends to cause more damage in the southern states (Sinclair et al. 1987). In North Dakota, oak leaf blister is frequently observed on the leaves of bur oak (*Quercus macrocarpa*).

The prevalence of infectious foliar diseases reflects an interaction between the host, the pathogen and the environment. Information about the pathogen's biology and its interaction with the host plant and environment is useful to understand why disease occurs, why the amount of disease changes from year to year, and how diseases can be effectively managed. Oak leaf blister serves as a good example for understanding these concepts.

Disease Symptoms

Oak leaf blister is a foliar disease caused by the fungus *Taphrina caerulescens*. As the name implies, symptoms appear as slightly raised bulges (blisters) on the leaf. During early to mid-summer, the upper surface of the blisters appears lighter in color compared with adjacent uninfected leaf portions (Figure 1). The undersides of these blisters often appear gray. Blisters range in size from 3 to 20 millimeters across, but at times coalesce and encompass the entire leaf. By mid- to late- summer, the upper surface of these blisters may desiccate and turn brown. Severely blistered leaves may curl and prematurely fall from the tree (Conway and Watkins 1986, Sinclair et al. 1987).

Figure 1. Typical appearance of oak leaf blister symptoms in early June. Photo by Michael Kangas.

The Causal Organism

There are approximately 100 known species of *Taphrina* that cause plant diseases (Alexopoulos et al. 1996). The genus is composed of parasitic fungi that cause galls, blister lesions and witches brooms on their hosts. Some of the notable disease-causing fungi of this group include: *T. communis* (causing plum pockets), *T. deformans* (causing peach leaf curl), and *T. populina* (causing yellow blister of poplar).

The life cycle of *T. caerulescens* is characterized by two distinct phases: a parasitic phase in which the fungus infects and survives in oak leaves and a saprophytic phase in which the fungus survives the winter (Sinclair et al. 1987, Alexopoulos et al. 1996). The fungus overwinters on twigs and bud scales and produces spores the following spring that infect developing leaves (Conway and Watkins 1986). Fully expanded leaves are not susceptible to infection (Sinclair et al. 1987).

Spores landing on the surface of developing leaves germinate and produce an infective mycelium that penetrates the leaf. Mycelium (pl. mycelia) is the term used to describe the vegetative body of fungi and is composed of numerous microscopic hair-like structures termed hyphae (sing. hypha). Mycelia of *T. caerulescens* penetrate the natural openings of oak leaves, but some believe that the fungus is capable of penetrating the leaf tissue directly (Taylor and Birdwell 2000).

Once inside the leaf, the mycelium of *T. caerulescens* grows intercellularly throughout the upper leaf tissue. The mycelium secretes growth-regulating chemicals that enlarge the host cells (termed hypertrophy). This process produces the bulging, curled leaf blisters that characterize the disease as the upper surface of the leaf enlarges faster than the lower surface (Sinclair et al. 1987, Alexopoulos et al. 1996).

Eventually, the mycelium gives rise to the reproductive spore-bearing structures of the fungus. These structures – termed asci (sing. ascus) – are microscopic sac-like fungal cells that produce and release ascospores. The asci of some fungi are produced within a more complex structure called a “fruiting body” that can be seen with the naked eye or a 10X hand lens. In contrast, the asci of *Taphrina* are not produced within a fruiting body. They are formed “naked” on the surface of the leaf. These only can be seen through a microscope (Figure 2).

During early summer, the asci burst and forcibly discharge the ascospores into the air. Ascospores give rise to a second form of spores called conidia that survive the winter as a saprophyte of bud scales. The conidia are spread to developing leaves by rain the following spring, thereby completing the life cycle (Conway and Watkins 1986, Sinclair et al. 1987).

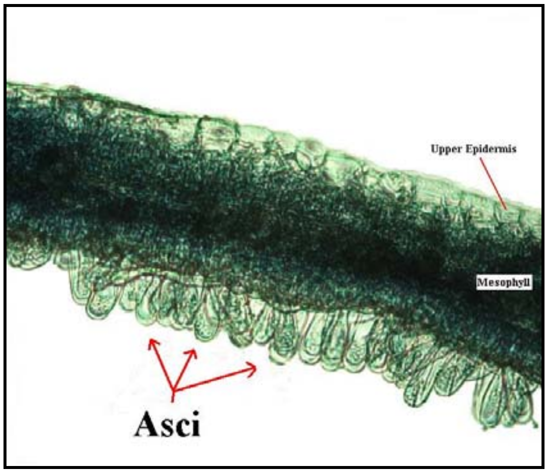

Figure 2. Cross-section of an oak leaf blister showing the sac-like asci of *T. caerulescens* as seen at 400X magnification. Photo by Michael Kangas.

Disease Management

Vigorous, healthy oaks sustain little damage from oak leaf blister infections and control of the disease is generally not warranted. Unlike most foliar pathogens, *T. caerulescens* does not extend its damage to the shoots and young twigs of infected trees. Oak leaf blister is strictly confined to the foliage and such damage rarely impacts the health of resilient oak trees.

Despite this, persistent oak leaf blister infections may stress young trees, newly transplanted trees or trees that are in poor health. Cultural practices that increase tree vigor, such as proper watering and mulching, will sufficiently minimize the damage caused by this pathogen.

Generally, the disease is an aesthetic concern to homeowners. High-value ornamental trees may benefit from chemical control during periods of high disease pressure. Protectant fungicides applied as dormant sprays prior to bud break may reduce infection. Various formulations of chlorothalonil and mancozeb are registered for controlling this disease. Some authors also recommend lime sulfur at a rate of 10 tablespoons per gallon or a Bordeaux mix. Fungicides are not effective once symptoms are present on expanding leaves because infection already has occurred. Removal of infected leaves has not been shown to effectively reduce disease occurrence (Conway and Watkins 1986, Zeleznik et al. 2005).

Disease Trends in North Dakota

The incidence and severity of foliar diseases caused by fungi are influenced by several factors. There must be an abundant and viable source of the fungus, the host must be susceptible and the environmental conditions must favor infection and disease development (Agrios 1997). Moisture is an important environmental condition for disease development because all fungi require some free water in order to carry out their normal metabolic processes (Alexopoulos et al. 1996).

Spores of *T. caerulescens* infect developing oak leaves from the period of bud-break through leaf expansion. As previously stated, the fungus does not infect fully expanded leaves. Therefore, high moisture levels must be present during the period of leaf expansion if infection is to occur. Typically, this period occurs from early to late May for bur oak (Ahlgren 1957).

Oak leaf blister increased significantly in eastern North Dakota during 2003 and 2004 because moisture conditions during the period of leaf expansion were high. Disease levels subsided during the following two years as May moisture declined in 2005 and 2006 (Figure 3). The fluctuation of oak leaf blister occurrence is typical of many foliar diseases. Although other factors influence disease development, general trends emerge when moisture conditions and the timing of plant growth are considered. Foliar diseases often persist at low levels for many years until a short-term change in moisture patterns provide favorable conditions for the pathogen to flourish. Moisture conditions in subsequent years may change again thereby impacting disease prevalence, as was the case with oak leaf blister in eastern North Dakota.

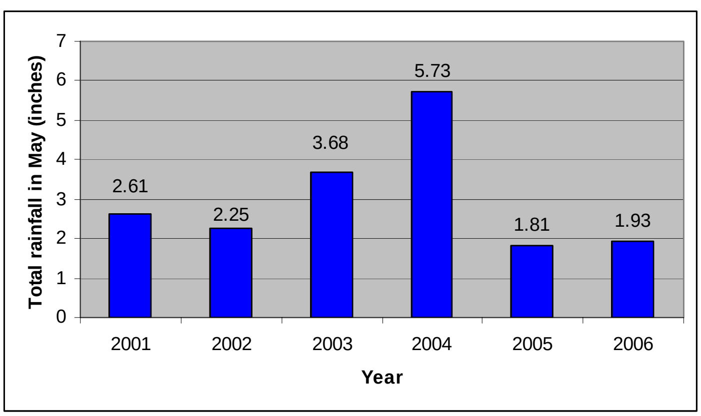

Figure 3. Total May rainfall for Fargo, N.D. from 2001 to 2006. Data Source: North Dakota Agricultural Weather Network.

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Small Talk – July 2006

Control of oak bullet gall wasp – leave some of them?

A recent article in the Minnesota DNR's "Forest insect & disease newsletter" discussed the oak bullet gall wasp, a.k.a. oak rough bullet gall (*Disholcaspis quercusmamma*). The insect lays its eggs in the dormant bud in the fall, and larvae begin to develop in the spring. Galls are formed by the tree in response to feeding by the larvae. Galls are most noticeable during the dormant season, when leaves are no longer on the trees. While the insect does not normally harm the tree, heavy infestations can result in twig or branch dieback.

Galls can be removed by hand, but the details may be a little tricky. Specifically, one study suggested that only galls that are 10 mm or larger in diameter should be removed in September. The smaller galls, 9 mm or less, should remain on the tree. The reason is that the smaller galls will have natural enemies of the bullet gall wasp in them. These enemies are other wasps that emerge in the spring to parasitize other galls.

Emerald ash borer confirmed in Illinois

On June 13, 2006, the Illinois Department of Agriculture announced that the emerald ash borer (EAB) was found in a yard in Kane County, about 40 miles west of downtown Chicago. This is the first time EAB has been found in Illinois. A coalition of local, state and federal agencies, including the USDA's Animal and Plant Health Inspection Service, U.S. Forest Service and the Illinois Department of Agriculture, has activated their response plan and began the task of eradicating it.

Inspectors have not determined how the beetle arrived in Illinois, but suspect it may have been transported there in contaminated firewood from a quarantined area in Michigan. EAB infestations have been confirmed in Illinois, Michigan, Indiana, Ohio and Maryland. Officials at the Illinois Department of Agriculture are optimistic that they can contain the pest, as they have had tremendous success dealing with the Asian long-horned beetle. For more information on the EAB, see the June 2006 issue of Tree Talk.