CEREAL RUST BULLETIN

Final Report

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- Stem rust was common throughout the northern Great Plains on wheat, barley and oat, but developed too late for major damage.
- Wheat leaf rust was less severe than in recent years except in the northern Great Plains where it has been higher than average for the last two years.
- Due to a mild winter and cool spring, stripe rust spread throughout the Great Plains, Southeast and Midwest to an extent not seen in 40 years.
- Oat crown rust was lighter than normal especially in the upper Midwest..

WHEAT STEM RUST. Except for light infections in Texas, there were few reports of stem rust in wheat fields in the southern U.S. in 2000. In mid-March, traces of wheat stem rust were found in soft red winter wheats growing in plots in southern Texas at the Uvalde experiment station.

By mid-April, wheat stem rust was severe in southern Texas plots and light in central Texas plots. By the second week in April, light amounts of stem rust were found on several entries in central Louisiana wheat plots. During late April, wheat stem rust was severe on a few susceptible cultivars in central Texas plots and light in north central Texas plots. In southern Texas at Uvalde, stem rust was severe throughout the plots. During the end of April, traces of wheat stem rust were observed in southern Louisiana plots.

In mid-May at the south central Kansas experiment station at Hutchinson, traces of wheat stem rust were found on the cultivar 2137. During late May, foci of 20% severity were observed scattered throughout a soft red winter wheat field in west central Missouri, and traces were found in a south central Kansas hard red winter wheat nursery. Light stem rust was observed on susceptible wheats during harvest in northern Texas wheat plots in late May. In mid-June, foci of stem rust were found in soft red winter wheat fields in northeastern Missouri, east central Illinois, west central Indiana, and south central Wisconsin.

1 foot from the center. In eastern Nebraska, leaves of hard red winter wheat were heavily infected, but stems were only slightly infected. On June 18, traces of stem rust were found on the hard red winter wheat cultivar 2137 in southeastern North Dakota. Rust pustules were on both the leaf blades and leaf sheaths, which is unusual for stem rust except when the spores are rain deposited, as likely occurred in the infections found in North Dakota and those seen in Nebraska.

By late June, 20% stem rust severities were reported in plots of susceptible winter wheat cultivars, e.g., 2174, in east central South Dakota and east central Minnesota. In winter wheat fields in northern Kansas and southern Nebraska, wheat stem rust developed late and since most of the wheat cultivars were early maturing they escaped the stem rust. The southern and central Great Plains, where the winters were mild this year, provided spores for susceptible wheats farther north. In much of the northern Great Plains the temperatures in early June were near normal and moisture levels were ideal for the spore infection process to occur.

By the first week in July, trace-20% stem rust severities were observed on the susceptible spring wheat varieties Baart and Morocco in south central Minnesota and eastern South Dakota plots. In the same south central Minnesota plots on June 22, only traces were observed on Baart wheat. The rust development was due to spores which were deposited with rains in early to mid-June. During the third week in June, most of the stem rust development was found on the leaves and by the first week in July, stem rust was found on both leaves and stems.

In the third week of July, 10-40% stem rust severity ratings were recorded on susceptible winter wheat cultivars like Norstar, Seward, and Windstar in east central North Dakota plots. On the susceptible spring wheat cultivar, Max, 40% severities were reported at the soft dough plant growth stage in late July at the east central North Dakota nursery. During the fourth week in July, trace to 5% severities were reported on older susceptible varieties like Baart, throughout plots in northwestern and central Minnesota and 5-40% severities in the rust nursery in central North Dakota. No wheat stem rust was observed by Cereal Disease Lab staff when conducting surveys in spring wheat fields in the upper Midwest this year.

As in 1999, the number of stem rust samples received at the Cereal Disease Lab this year was twice the number in recent years. The increased severity of stem rust can be attributed to the large amount of inoculum produced on susceptible winter wheat cultivars, e.g. 2137, farther south in the Central Plains and to the temperature and moisture, which were ideal for stem rust infection in the Northern Plains this year. If current spring wheat cultivars were susceptible to stem rust, a serious epidemic with substantial yield losses would have occurred.

To date, races Pgt-QCCJ, QCCS, QCMS, QCRS, RCMS and RCRS (Table 1) are the most common races identified from collections made in the southern U.S. The QCCJ race is virulent on barley cultivars with the *Rpg1* (T) gene for resistance. The RCRS race was the most commonly identified race in 1998 and 1999. In 1999, races QCCS and QCMS were only found in North Dakota and this year they have been identified from Texas rust collections.

WHEAT LEAF RUST. Southern Plains - In early February, light amounts of leaf rust were found on the susceptible cultivar TAM107 in central Texas plots, but near drought conditions throughout much of Texas kept rust development to a minimum. In early March, leaf rust increased rapidly in south and north central Texas wherever moisture was present for rust infection to occur. By the third week in March, 10-40% severity rust readings were observed on the lower leaves of susceptible cultivars in southern Texas at the experiment stations in Uvalde and Beeville.

During the third week in April, leaf rust was severe in plots from south to north Texas on susceptible cultivars, but rust development was light in Texas farm fields (Fig. 1). The mild winter and rainfall in late March and early April contributed to the rust development in much of this area. In mid-April, leaf rust severities of 60% were observed in central Texas plots of TAM-107.

In early April, leaf rust was light in fields throughout Oklahoma. In central Oklahoma plots, 10-30% severities were observed on the lower to mid leaves.

During the last week of April, wheat leaf rust severities in north central Texas and southern Oklahoma plots ranged from trace to 80%. Severities were as high as 70% in fields where rust overwintered. By early May, rust increased throughout Oklahoma. The mild winter and rainfall in late March and early April contributed to the rust development in most of this area. This region provided leaf rust inoculum for wheat grown farther north.

Central Plains - Leaf rust was light throughout south central Kansas in early April. During the third week in April, in south central Kansas plots, 10% severities were observed on the mid leaves. In Kansas, only light amounts of leaf rust overwintered, which is the same as in 1998 and 1999.

In early May, traces of leaf rust were found on the flag leaves of susceptible wheat cultivars in fields in the southern half of Kansas (Fig. 1). This is similar to leaf rust development last year.

By the third week in May, 100% severities were observed on susceptible cultivars in south central Kansas plots. Some cultivars, e.g., Jagger, had 30% severities in fields, but leaf rust was light in fields of 2174. Rust was light in north central Kansas because of the dry conditions which prevented rust infections during early May.

During the last week in May, trace to 80% severities were reported on winter wheat cultivars in south central Kansas nurseries. In fields in the same area, 40% severities were observed on susceptible cultivars like Jagger, but on most of the other cultivars severities were 1% or less. In north central Kansas and west central Missouri, 20% severities were observed on susceptible cultivars at the early berry stage. In late May, in south central Kansas spring wheat plots (i.e., 2375), trace to 20% severities were observed at the 1/4 berry stage. During April and early May, leaf rust development was slowed throughout the central Great Plains because of moisture shortage, but with rain and dew in mid-May conditions for leaf rust infection improved. However, near the end of May, the hot windy conditions made conditions less than ideal for rust development. In 2000 the overall estimated loss due to leaf rust in Kansas was 2.9%, which is below the 10-year average of 4.8%, but close to last year's estimate of 3.5%.

Yield losses were estimated from fungicide plot data, cultivar surveys, cultivar disease ratings and disease surveys.

During late May, traces of leaf rust were found in southeastern Nebraska winter wheat plots and fields.

Northern Plains - At Rosemount, Minnesota, viable leaf rust pustules that had apparently overwintered were found on April 27 on lower leaves in hard red winter wheat plots.

On May 30, traces of leaf rust were observed on the leaves of winter wheat cultivars in east central North Dakota plots. The rust development in the North Dakota plots probably originated from rust spores that were deposited with rain around the middle of May. The timing of this rust development was the same as last year.

During the first week in June, 10% leaf rust severities were observed on the flag leaves of susceptible winter wheat cultivars and traces on the lower leaves of susceptible spring wheats in Rosemount, Minnesota plots.

By mid-June, 20% severities were reported on susceptible winter wheat cultivars at the early boot stage in east central North Dakota. In mid-June, trace to 15% severities were observed on susceptible spring wheat cultivars in central North Dakota.

During the final week in June, leaf rust on winter wheat was moderate in central and western South Dakota and moderate to severe in eastern South Dakota. Susceptible cultivars like Alliance, Jagger, TAM 107 and Rose had 100% severities at the soft dough maturity stage in east central South Dakota varietal plots. The rust infections in South Dakota probably originated from inoculum sources in Oklahoma and Kansas. As in previous years winter wheat flag leaves senesced because of leaf rust and hot windy conditions throughout South Dakota.

In late June, susceptible winter wheat cultivars had leaf rust severities ranging from 20-50% in southeastern North Dakota plots.

During the first week in July, leaf rust severities of 60% were reported on the flag leaves of susceptible spring wheat cultivars, e.g., 2375 and Oxen, in south central Minnesota plots. In fields, severities ranged from trace to 10% on the lower leaves of spring wheats in western Minnesota and eastern South Dakota. This year, leaf rust was not as severe and concentrated in the Upper Midwest as last year when 3-4% losses occurred in the Dakotas and Minnesota. This year less rust inoculum arrived from the south, but spring wheat cultivars currently grown are less resistant to leaf rust than 10 years ago. However, one of the more susceptible spring wheat cultivars, AC Barrie, was generally removed from production in 2000.

In late July, trace-10% severities were found in spring wheat fields and trace to 80% severities in plots throughout northeastern Montana, central and northern North Dakota and western Minnesota. Throughout northeastern North Dakota more fields were sprayed for fungal diseases than in past years. This year in southern North Dakota rust was normal but less than last year. In the northern spring wheat growing area some losses are expected, especially in late planted fields and in fields that were not sprayed.

Canada - By late July, in fields not sprayed with fungicides, trace to 5% severity was found on wheat in southeastern Manitoba. Leaf rust infections in the south central area were lighter with only trace amounts of leaf rust. Late planted wheat fields seeded with susceptible varieties may experience significant yield losses.

Southeast and East - In early February, light leaf rust was found in susceptible spreader rows in southern Louisiana. Rust development was slower starting than normal because of the lack of moisture throughout the southern soft red winter wheat area. In early March, wheat leaf rust was increasing throughout the state of Louisiana and by late March severe leaf rust was observed in the plots in southern Louisiana. By late March, leaf rust was severe on susceptible cultivars in nurseries in west central Mississippi, while most of the commercial fields in the area were sprayed and did not have rust.

During late March, light leaf rust was found in plots of susceptible lines in southwestern Georgia and the Panhandle of Florida. By mid-April, plots of susceptible wheat had moderate leaf rust infection and fields within 75 miles of the Gulf Coast had light infection. Leaf rust development in much of the Southeast was inhibited by drought conditions. Wheat plots in central South Carolina had 30-50% leaf rust severities in mid April. A few plots of susceptible soft red winter wheats in the Southeast had 80% leaf rust severities by earl May, but fields generally had trace to 20% severities. Fungicides were applied in a few fields, e.g. Coker 9835, to control leaf rust. Dry weather in the Southeast limited rust development, and fewer spores than usual were available for spread to areas further north.

In late April, in Arkansas, leaf rust had increased where rust overwintered. Some cultivars that were severely rusted in previous years were resistant while other cultivars, e.g., Shiloh, were susceptible, which indicates a change in the race population in that area.

By the third week in May in northeastern Arkansas, leaf rust was generally light in plots and fields but was severe on a few cultivars, e.g., Shiloh. Leaf rust also was light in southwestern Kentucky plots during the third week in May.

In most of the southeastern U.S., weather was drier and cooler than normal through March and most of April and was a limiting factor in rust development. In late April, frequent rains occurred which were followed by rapid leaf rust increase on susceptible cultivars. Because the crop matured so fast losses to leaf rust were limited.

In North Carolina in 2000, wheat leaf rust was first observed in the middle of March in breeding plots at Plymouth and Kinston. The leaf rust infections were widely scattered on plots of susceptible wheat lines, which indicated that infections may not have overwintered in 2000 compared to 1999 when infections were found in the middle of February and tended to be concentrated in smaller areas. The severity of leaf rust infection on susceptible lines increased slowly through the spring, reaching near 100% by the second week of May.

In fields infections levels were generally light to moderate, due to the cultivation of leaf rust resistant cultivars. Dry weather in the first part of May also reduced rust severity. Infection levels were heaviest in the coastal plain region, where the majority of the wheat is grown in the state. In the Piedmont region near Raleigh, very little rust could be found The cultivar Coker 9663, which was widely grown in 2000 had little if any rust infection in fields, or in nursery plots. Coker 9835 which is also widely grown, had moderate to high levels (20-50%) in nursery plots. Pioneer 2580 had moderate levels of rust infection in both nursery plots and fields.

Wheat lines and cultivars with combinations of adult plant genes *Lr12* and *Lr34* had a high level of resistance. Adult plant gene *Lr13* did not provide effective resistance, either singly or in lines with other genes. Test lines of wheat with single genes *Lr*9, 16, 17, 19, 21, 23, 24, 25, 26, 29, 33, 41,42 and 43 at Kinston, NC showed useful resistance to leaf rust.

By late May, 5 to 80% leaf rust severities were reported on wheat in nurseries in eastern Virginia.

In mid-June, trace levels of wheat leaf rust were common in wheat fields of central and western New York. Both May and June were characterized by above normal precipitation and below normal temperatures.

Midwest - During late May, in central Indiana, leaf rust was increasing on the upper leaves of plants on which Septoria had destroyed the lower leaves.

By the second week in June, 40% leaf rust severities were reported in plots of susceptible soft red winter wheat cultivars from northeastern Missouri to northwestern Ohio and in fields severities ranged from 0 to 10% (Fig. 1). In fields in northwestern Ohio, 5% severities were noted on 20% of the wheat plants at the 1/2 berry maturity stage.

In mid-June, traces levels of wheat leaf rust were common in wheat fields in southern Wisconsin. Both May and June were characterized by above normal precipitation and below normal temperatures.

California - In early May, 20-80% leaf rust severities were reported on wheat lines growing in southern California nurseries.
In mid-May, leaf rust severities were low in California commercial wheat fields, but 50-100% severities were reported on a few lines and varieties in nurseries in central and southern San Joaquin Valley.

Pacific Northwest - In early July, wheat leaf rust was increasing on spring wheats in eastern Washington fields and susceptible wheats in nurseries had 60-70% severities.

Wheat Leaf Rust Virulence - The preliminary 2000 leaf rust race identifications from collections made in the U.S. are presented in Table 2. From the central and southern Plains rust collections the most common races were M-races(virulent to *Lr*1,3,10,17,+). Many of the MBDP and MCDP races were identified from rust collections made from Jagger which is grown on significant acreage in the southern and central Plains states. There also has been an increase in the number of T-- races (virulent to *Lr*1, 2a,2c, 3, +), particularly, an increase in T-- races with virulence to *Lr*9 and 10 in the southern soft red winter wheat area. This *Lr*9 and 10 combination has rarely been found in past leaf rust surveys.

WHEAT STRIPE RUST. South - In early March, light amounts of stripe rust were found in a wheat field in southern Louisiana. In late March, light stripe rust was found in plots in northeastern Louisiana.

In mid-March, stripe rust was widespread on the lower leaves and upper leaves of several cultivars in northwestern Arkansas where the rust had overwintered.

By the third week in April, wheat stripe rust was severe in commercial fields throughout northwestern Louisiana.

During mid-April, stripe rust was increasing throughout the state of Arkansas. Foci several hundred feet in diameter were found where stripe rust had overwintered. More Tilt was sprayed this year than in any of the last 5 years.

During late March, infections of stripe rust that had overwintered were found on the lower leaves of soft red winter wheat cultivars at the Uvalde,Texas experiment station.

By the third week in April, wheat stripe rust was severe in commercial fields throughout northeastern Texas and northwestern Louisiana. Entire fields were yellow from top to bottom and many fields were abandoned because of stripe rust. Many fields were sprayed with the fungicide Tilt which reduced yield loss. Late maturing soft red winter wheat fields had high stripe rust severities. The high level of stripe rust in March-April was due to the mild winter which allowed wheat to start growing early and more rust to overwinter. In the early spring there was good moisture with cool nighttime temperatures which provided perfect conditions for stripe rust development.

By late April, wheat stripe rust was severe from northeastern Texas and southern Oklahoma to northeastern Arkansas. It has been estimated there will be a 10% loss to wheat stripe rust in northeastern Texas.
As of early May, stripe rust was still increasing in northern Arkansas (Fig. 2) because there still had not been any prolonged periods of hot weather, which usually stops stripe rust development. This year, stripe rust was reported in a southern Georgia nursery for the first time since 1974. In late April, stripe rust was light in plots in northern Alabama. In west central Mississippi plots where it was dry, wheat stripe rust was more scattered and easier to evaluate than wheat leaf rust.

During the third week in May in northeastern Arkansas, active stripe rust sporulation was observed in wheat plots and fields. The crop matured fast and with the arrival of hot temperatures stripe rust development stopped. By the third week in May, 50% of the entries in northwestern Arkansas plots were either destroyed by stripe rust or severely damaged.

In mid-May, stripe rust was found throughout Kansas. The mild winter and cool spring were conducive for stripe rust development. In south central Kansas plots, stripe rust was severe on a few of the hard red winter cultivars, especially those with the 1B-1R gene translocation, which indicated a possible virulence to *Yr*9. Losses to wheat stripe rust in Kansas were estimated to be 0.05%.

Trace amounts of stripe rust were found in wheat breeding plots at Brookings, South Dakota in mid-May. The wheat plots ranged from late boot to heading stage.

In late May, stripe rust was observed throughout eastern Kansas, northwestern Missouri and southeastern Nebraska fields. In south central Kansas plots, severities ranged from traces to 60% while in Nebraska fields, 1% severities were observed. This year in the Great Plains the cool spring and nighttime temperatures, which were in the low 50s, were favorable for stripe rust development. However, the hot windy conditions the later part of May probably disrupted much of the stripe rust development.

On June 8, light amounts of wheat stripe rust were found in soft red winter wheat plots at Rosemount, Minnesota. Hot temperatures that followed the initial rust sighting in the Minnesota plots may have delayed the rust development, but cooler weather in mid-June allowed further increase.

In mid-June, traces of wheat stripe rust were found on the cultivar 2137 in southeastern North Dakota

During the second week in June, wheat stripe rust was found in a northeastern Colorado field. Normally, stripe rust is found at higher elevations in Colorado, i.e, San Luis Valley (7,500 ft) or in the front range of the Rockies.

In late June, wheat stripe rust was widespread in central and eastern South Dakota on winter wheat. In plots at Brookings, some winter wheat plots had a high level of infection, e.g., 80% on Siouxland. Traces of stripe rust were found easily in spring wheat fields and nursery plots. In foci, 30% severities were observed in some spring varieties and lines. By the later part of the first week in July, stripe rust development had slowed in South Dakota because of the hot temperatures during the day and temperatures at night that were greater than 60 degrees.
By late July, traces of stripe rust were found in spring wheat fields and 50% severities were reported in irrigated plots in northeastern Montana. Traces of stripe rust were scattered throughout northern North Dakota spring wheat fields and in plots severities ranged from trace to 20% (e.g. McNeal and NorPro). There was little yield loss to stripe rust in the northern Great Plains.

Canada - In late July, trace to l5% stripe rust severities were reported in spring wheat fields in southeastern and south central areas of Manitoba. Due to the early planting of most cereal fields this year and cooler than average June temperatures, susceptible wheat varieties that were not sprayed with fungicides experienced low levels of stripe rust infection and associated yield losses. However, later planted fields avoided infection due to higher July temperatures that impeded further development of stripe rust.

Midwest - In central Indiana, light stripe rust was found in late May in fields and in breeding nurseries where it was more severe.

By mid-June, wheat stripe rust development was extensive from central Illinois to southwestern Michigan and severities ranged from traces to 20%. This was the most widely dispersed stripe rust development observed throughout the northern soft red winter wheat area in at least 20 years. In the northern most locations rust severities ranged from trace to 10% with large sporulating pustules. At many of these locations stripe rust was found together with leaf rust on the same leaf which could mean that they developed from the same spore shower. Much of this stripe rust development originated from spores produced farther south in Texas, Arkansas, or adjacent states.

East - On May 9, a wheat stripe rust focus 1m in diameter, was found in northwest Georgia. This is one of the first records of stripe rust ever being found in north Georgia. In mid-May, traces of stripe rust were found in plots in Blacksburg, Virginia. This is one of the first reports of wheat stripe rust east of the Appalachian mountains.

Wheat stripe rust this year was the most widespread throughout the southern U.S. than has ever been reported (Fig. 2). Last year, no stripe rust was reported in south central U.S., but two years ago light amounts of wheat stripe rust were scattered from the lower Mississippi Valley north to east central Minnesota. This year stripe rust was found early because it overwintered in many areas in the southern U.S., where the winter was milder than normal. Furthermore, the spring weather has been cooler than normal, favoring stripe rust development. It appears that there was a large source of inoculum that arrived early in the southern U.S. from Mexico. Preliminary data from the wheat stripe rust collections indicate a shift in the stripe rust virulences from 1998 to 2000 in the southern U.S.

California - In mid-May, temperatures were cool and several storm systems provided moisture that allowed stripe rust to continue to increase in the Central Valley of California. There were reports of wheat stripe rust at 100% severity in commercial fields of the widely grown variety RSI 5 throughout the Sacramento Valley and the northern part of the San Joaquin Valley. Cool spring weather also allowed wheat stripe rust to increase in commercial fields of several varieties in the central and southern portion of the San Joaquin Valley. Severities of 100% were observed on breeding lines and varieties in nurseries in this area.

Pacific Northwest - By mid-March, wheat stripe rust was increasing in plots and fields in western Washington.

In mid-April, wheat stripe rust severities of 60% were reported on susceptible winter wheat lines in the Skagit valley nursery in western Washington.

During the first week in May, wheat stripe rust was prevalent throughout the state of Washington. Stripe rust exceeded 70% severity on susceptible winter wheat cultivars in northwestern Washington.

By late May, in eastern Washington, stripe rust was starting to increase in winter wheats and development was slower than normal because of the dry conditions in early and mid-May which were not conducive for rust development.

By late June, wheat stripe rust was starting to increase on spring wheats in the Pacific Northwest, and the susceptible cultivars were sprayed with fungicides. Rust losses were minimal, since most of the cultivars have high temperature, adult plant resistance.

OAT STEM RUST. In late March, stem rust was found in oat plots in a southern Louisiana nursery. In mid-April, oat stem rust was light in southern Louisiana nurseries. The oat stem rust increased slowly because of the cooler than normal temperatures during the first half of April. Rust development was much less than last year, when rust killed many of the lines in the Baton Rouge nursery by mid-April. During the first week in May, in central Louisiana plots, oat stem rust developed to moderate levels on susceptible cultivars that were not severely infected with crown rust.

During the first week in May, oat stem rust overwintering foci were found in plots in southern Georgia and southern Alabama. The rust killed the oats in these plots and moved outward onto oat growing around the infected foci.

In early April, oat stem rust was severe in southern Texas plots and moderate in central Texas plots. Oat stem rust development was equal to last year throughout the southern U.S.

In late May, traces of oat stem rust were observed on some cultivars in a south central Kansas plot. In mid-June, trace to 40% stem rust severities were observed in oat plots at the berry growth stage in northeastern Missouri. Oat acreage is limited in the central Plains states, which reduces the rust inoculum for the northern plains oat crop.

During late June, 1% oat stem rust severities were found in commercial fields in south central Wisconsin and trace-5% severities were reported in plots in south central Minnesota and east central South Dakota. In general, oat stem rust was less widespread than last year on the same date, throughout the northern oat-growing area.

By late July, trace to 5% severities were observed in oat plots from central Minnesota to central North Dakota. Losses to oat stem rust will be minimal this year in the upper Midwest.

In late July, trace amounts of oat stem rust were found on susceptible trap plots and wild oat in the southeastern and south central areas of Manitoba. Many oat fields were sprayed with fungicide this year, so losses due to rust infection are expected to be light this year.

During the last week in April, traces of oat stem rust were found on wild oat (*Avena fatua*) in a plot in Butte, California. On May 22, limited oat stem rust was found on wild oats in Sonoma County, California.

OAT CROWN RUST. In early March, in south Texas plots, crown rust infections were severe in susceptible plots and increased at a rapid rate wherever moisture was present.

In early March, traces of oat crown rust were found in southern Louisiana. In late March, in southern Louisiana, crown rust increased in oat plots and some lines had severities as high as 60%. In late March, light amounts of crown rust were found in oat plots along the Gulf Coast and some overwintering sites were observed in locations like Headland, Alabama.

Oat crown rust increased rapidly during April from south central Texas through southern Louisiana to southern Alabama. During mid-April, crown rust was severe in these areas like last year, but there was less crown rust further east. During mid-April, 50 - 75% crown rust severities were observed on susceptible oat plots in the Baton Rouge, Louisiana nursery. By late April, crown rust was severe in plots of susceptible cultivars and light in commercial fields in the southern U.S. In much of this area, the drier and cooler than normal weather during April was not conducive to rust development. These southern areas provided some inoculum for areas farther north.

In late May, traces of crown rust were found in oat plots in south central Kansas and a collection of crown rust was made from *Avena fatua* in Sonoma County, California.

In early May, pycnial infection was noted on buckthorn bushes at St. Paul, Minnesota. In the buckthorn nursery, most of the pycnia were found along the edge of the nursery rather than where the oat telial straw was located. Therefore, the first pycnia observed may be from f. sp. of *Puccinia coronata* that infect grasses rather than oat. The timing of this pycnial development, in early May, is near normal.

By the fourth week in May at St. Paul, Minnesota, a few uredinia were found on the oat spreader rows in the buckthorn nursery. The main flush of new pycnia did not appear in the buckthorn nursery at St. Paul until early May. Cool weather delayed development of aecia.

During late May, crown rust aecial infections were found on buckthorn bushes in east central North Dakota.

By mid-June, oat in the buckthorn nursery in St. Paul, Minnesota, had high levels (80% severities) of crown rust infection on lower leaves and 5% severities on the upper leaves in the spreader row. Traces of crown rust were found on oat in the other St. Paul nurseries. In mid- June, trace levels of oat crown rust were detected in south central Wisconsin fields.

In early July, 40% crown rust severities were observed on flag leaves of oat in south central Minnesota plots, while in fields 1-5% severities were found on the lower leaves. In early July, crown rust had developed very slowly in east central South Dakota and west central Minnesota nurseries with trace to 20% severities on lower leaves of cultivars at the milk growth stage.

By late July, trace to 50% crown rust severities were observed in varietal plots in eastern and central North Dakota. In western North Dakota plots rust was not found. Crown rust on oat was lighter than in previous years except on susceptible cultivars. On wild oat(*Avena fatua)* plants in west central Minnesota, 80% severities were common while in northwestern North Dakota only traces of crown rust were present. Crown rust losses in the northern oat-growing area were less than the average of the past 5 years.

During the third week in May, aecia were observed on buckthorn on the Cornell University campus in New York. In mid-July, severe rust was reported in field of a susceptible cultivar, but in general losses to crown rust were light in the eastern U.S.

In late June, crown rust severities were more severe and infections earlier than normal on susceptible oat yield plots at Guelph, Canada.

By late July, trace to 5% levels of crown rust were found on wild oat (*Avena fatua*) and susceptible trap plots in the southeastern and south central areas of Manitoba. Aecial infections on buckthorn were heavier in July than has been found in recent years. Crown rust was severe with up to 70% severities on wild oat in experimental plots at the University of Manitoba, which is adjacent to the Boyne River where buckthorn is found. The cultivar Triple Crown with Pc48 had trace to 10% crown rust severities in plots adjacent to the wild oat plots.

As of the middle of June, when oat crown rust virulence tests were suspended for the summer, 40 isolates from Texas and 18 isolates from the Southeast had been tested. Among these isolates 41 different races were identified with the standard set of 16 differentials. As in 1999, the LB-- and LQ-- race groups were most common, accounting for nearly half the isolates. LB- indicates virulence on Pc40 and avirulence on Pc38, 39, 45, 46, 48, 50, and 68. LQ- indicates virulence on Pc38, 38, and 40 and avirulence on Pc45, 46, 48, 50, and 68. Frequencies of virulence on the extended set of differentials are shown in Table 3. Virulence to Pc68 was found in one isolate each in Texas and Alabama. No isolates were identified with virulence to Pc45, 53, 62, TAM-O-393, or Vista.

BARLEY STEM RUST. In early April, a barley stem rust collection was made in the Uvalde, Texas plots. Stem rust on barley rarely occurs in the southern U.S.

In early July, 5% stem rust severities were observed on 10% of the plants of the 2-row barley Hypana, in west and south central Minnesota plots. No stem rust was found on barleys with the T- gene, e.g., Robust.

In mid-July, 10% stem rust severities were reported on wild barley (*Hordeum jubatum)* growing alongside the roadway in eastern South Dakota and west central Minnesota. The last 2 years, stem rust observed on wild barley has been very extensive throughout the northern Great Plains. The rust developed early on the wild barley because of the early spring and resulting earlier maturity of the wild barley. In general, barleys are more susceptible to stem rust as they mature. If current spring wheat cultivars were more susceptible to stem rust, the stem rust on wild barley could be a significant source of inoculum and substantial yield losses would occur.

In late July, 70% severities were observed on 6-rowed barleys (e.g. Bowman) in east central South Dakota plots. During late July, traces of stem rust were found on 2 & 6 row barleys growing in plots from northeastern Montana to west central Minnesota and none was found in commercial fields. There was less stem rust observed on barleys this year in the northern Great Plains which may be due to less QCCJ (stem rust race which infects *Rpg (*T gene) found in the southern U.S. compared to 1999 (Table 1).

In late July, trace amounts of stem rust were found on wild barley in both the southeastern and south central regions of Manitoba.

STRIPE RUST ON BARLEY. In early April, stripe rust was found on winter barley cultivars and experimental lines in plots in Corvallis, Oregon.

In mid-April, barley stripe rust was severe on susceptible lines and crosses in a nursery in the Sacramento Valley of California.

In mid-April, stripe rust severities of 20% were reported on susceptible winter barley lines in the Skagit Valley nursery in western Washington.

By early May, barley stripe rust was observed in nurseries in the Sacramento and San Joaquin Valleys of California with severities of 80-100% on susceptible cultivars. In northwestern Washington, 70% severities were reported on susceptible winter barley cultivars at the late jointing stage.

By mid-May, barley stripe rust increased throughout the Central Valley of California reaching 100% severities on susceptible varieties and breeding lines at the soft-medium dough stage. In a large screening nursery (3000 entries) at Davis, California, 33% of the entries were rated at 100% severity and 50% were rated at 50% severity.

In late May, in eastern Washington, barley stripe rust increased, but development was slower than normal because of the dry conditions in early and mid-May. By late June, stripe rust on barley was starting to increase on spring barley in eastern Washington and susceptible cultivars were rated from 20 to 50% in plots. In the Pacific Northwest barleys susceptible to stripe rust were sprayed with fungicides this year, so losses to rust infection were light this year.

BARLEY LEAF RUST. In early April, light barley leaf rust was found in plots at Uvalde, Texas.

In early July, 40% severities were reported on lower leaves in spring barley plots in south and east central Minnesota and east central South Dakota.

In late July, traces of barley leaf rust were found in plots in central Minnesota. Losses to barley leaf rust in the U.S. were minimal this year.

By the second week in May in Ontario, Canada, barley leaf rust was found on susceptible winter barley plots where the rust had overwintered. In late June, barley leaf rust was moderate on winter barley yield plots and was starting to appear on susceptible spring barley near winter barley strips at the Guelph, Canada research station.

During late March, leaf rust (*Uromyces hordeinus*) on little barley (*Hordeum pusillum*) was found along the Gulf Coast of the U.S.

BARLEY CROWN RUST. In mid-June, traces of crown rust were observed on barley near the buckthorn nurseries at Fargo, North Dakota and St. Paul, Minnesota.

In late June, traces of crown rust were found in plots and fields in eastern South Dakota and in south central and east central Minnesota plots.

RYE STEM RUST. During late April, 10% rye stem rust severities were reported in a central Texas plot.

In late July, traces of stem rust were found in Minnesota rust detection plots of Prolific rye. In late July, resistant and susceptible plant mixtures (10-20% severities) were observed on winter ryes in an east central North Dakota nursery.

RYE LEAF RUST. During late March, 20-50% rye leaf rust severities were observed on rye growing in plots within 75 miles of the Gulf Coast in Alabama and Florida.

In late April, 60% rye leaf rust severities were reported on cultivars throughout plots in the southeastern U.S.

In late May, 5% leaf rust severities were observed on rye in a south central Kansas field.

In mid-June, 40% leaf rust severities were reported in a rye field in northwestern Ohio.

By early July, 40% leaf rust severities were found on upper leaves of spring rye in plots in southern and west central Minnesota. In late July, 50% severities were reported on susceptible spring ryes in north central Minnesota.

STEM RUST ON BARBERRY. During the second week in May and mid-June, stem rust aecial infections were found on susceptible barberry bushes in south central Wisconsin and southeastern Minnesota.

This is the last issue of the Cereal Rust Bulletin for the 1999-2000 growing season. I would like to thank all of those who helped with the bulletin this year, especially Mark E. Hughes who coordinates its distribution through the CDL website (http://www.cdl.umn.edu), email (markh@cdl.umn.edu) and the post. Any reports of rust that you found in your area were appreciated and this information was added on our web page and Cereal Rust Bulletins.
- David L. Long (davidl@cdl.umn.edu)

Table 1. Preliminary identification of wheat stem rust races identified through August 4, 2000

	Number of Isolates		
Pgt-code	Texas	Louisiana	Missouri
QCCJ	7		
QCCL	1		
QCCS	7	6	
QCMJ	2		
QCMS	26		2
QCRS	15		
QTHS			1
RCMS	12		3
RCRS	8		
RKQQ	1		
RKRS	1		

Table 2a. Preliminary identification of wheat leaf rust races identified through August 4, 2000

Pt code[1]	Virulence formula[2]	Number of isolates by state										
		AL	AR	CA	FL	GA	IL	IN	KS	LA	MI	MN
FBGD	2c,3,11,14a									1		
FBMT	2c,3,3ka,10,14a,18,30,B							2		4		
FCMT	2c,3,3ka,10,14a,18,26,30,B									2		
KFRS	2a,2c,3,3ka,10,11,14a,18,24,26,30				1							
LBBL	1,10							1				
MBBN	1,3,10,14a			1								
MBDN	1,3,10,14a,17									4		
MBDP	1,3,10,14a,17,B						2	5	67			
MBGN	1,3,10,11,14a			3				1				
MBRL	1,3,3ka,10,11,30	2			1							
MBRN	1,3,3ka,10,11,14a,30	2										
MBRR	1,3,3ka,10,11,18,30,B	2										
MBRS	1,3,3ka,10,11,14a,18,30	8	2		1			1				
MCDP	1,3,10,14a,17,26,B		1	2				4	10	2		6
MCRJ	1,3,3ka,11,14a,18,26,30									4		
MCRN	1,3,3ka,10,11,14a,26,30					1						
MCRS	1,3,3ka,10,11,14a,18,26,30	43	2		5	2		5		20	2	
MCTP	1,3,3ka,10,11,14a,17,26,30,B								3			
MDBP	1,3,10,14a,24,B											1
MDMN	1,3,3ka,10,14a,24,30	4										
MDRN	1,3,3ka,10,11,14a,24,30								4			
MDRS	1,3,3ka,10,11,14a,18,24,30									2		
MNRS	1,3,3ka,9,10,11,14a,18,24,30	1										
PCRT	1,2c,3,3ka,10,11,14a,18,26,30,B	2										
TBBN	1,2a,2c,3,10,14a									2		
TBBS	1,2a,2c,3,10,14a,18					1						
TBHT	1,2a,2c,3,10,11,14a,18,30,B								2			
TBRP	1,2a,2c,3,3ka,10,11,14a,30,B								1			
TBRT	1,2a,2c,3,3ka,10,11,14a,18,30,B									2		
TCBN	1,2a,2c,3,10,14a,26							4				4
TCBP	1,2a,2c,3,10,14a,26,B								2	6		
TCBT	1,2a,2c,3,10,14a,18,26,B									2		
TCDP	1,2a,2c,3,10,14a,17,26,B				1							
TCMN	1,2a,2c,3,3ka,10,14a,26,30										2	
TCRN	1,2a,2c,3,3ka,10,11,14a,26,30	10	2							10		
TCRS	1,2a,2c,3,3ka,10,11,14a,18,26,30	2										
TDRN	1,2a,2c,3,3ka,10,11,14a,24,30		2									
TFDN	1,2a,2c,3,10,14a,17,24,26									2		
TFRN	1,2a,2c,3,3ka,10,11,14a,24,26,30		1							2		
TLBN	1,2a,2c,3,9,10,14a					2						
TLBP	1,2a,2c,3,9,10,14a,B	1										
TLGJ	1,2a,2c,3,9,11,14a,18	5			4	10				4		
TLGN	1,2a,2c,3,9,10,11,14a				2	5				9		
TLGS	1,2a,2c,3,9,10,11,14a,18									4		
TLRJ	1,2a,2c,3,3ka,9,11,14a,18,30							2				
TNBN	1,2a,2c,3,9,10,14a,24	2										
TNMN	1,2a,2c,3,3ka,9,10,14a,24,30							2		6		
TNMS	1,2a,2c,3,3ka,9,10,14a,18,24,30									2		
TNRN	1,2a,2c,3,3ka,9,10,11,14a,24,30		2							13		
Number of isolates		84	12	6	15	21	2	27	89	103	4	11
Number of collections		46	7	4	11	15	1	19	55	53	2	7

Table 2b. Preliminary identification of wheat leaf rust races identified through August 4, 2000

Pt code[1]	Virulence formula[2]	Number of isolates by state										
		MO	MS	NC	ND	OH	OK	SC	SD	TX	VA	WI
LBBS	1,10,14a,18									2		
LCRS	1,3ka,10,11,14a,18,26,30			2								
MBBN	1,3,10,14a			2								
MBDL	1,3,10,17						2					
MBDP	1,3,10,14a,17,B	4			2	1	4		4	34		1
MBMP	1,3,3ka,10,14a,30,B		2									
MBRN	1,3,3ka,10,11,14a,30									7	2	
MBRS	1,3,3ka,10,11,14a,18,30	1		35		2		2				
MCBP	1,3,10,14a,26,B										4	
MCDF	1,3,14a,17,26,B								1			
MCDP	1,3,10,14a,17,26,B						8		2	7		
MCMN	1,3,3ka,10,14a,26,30	1										2
MCMT	1,3,3ka,10,14a,18,26,30,B									2		
MCRS	1,3,3ka,10,11,14a,18,26,30			21				4				
MCRT	1,3,3ka,10,11,14a,18,26,30,B			4								
MDGN	1,3,10,11,14a,24									2		
MDMN	1,3,3ka,10,14a,24,30									2		
MFMN	1,3,3ka,10,14a,24,26,30									1		
MLBN	1,3,9,10,14a									2		
PCRT	1,2c,3,3ka,10,11,14a,18,26,30,B			2								
TBBN	1,2a,2c,3,10,14a	2								5		
TBDN	1,2a,2c,3,10,14a,17									2		
TBRT	1,2a,2c,3,3ka,10,11,14a,18,30,B	2		1								
TCDP	1,2a,2c,3,10,14a,17,26,B									6		
TCMN	1,2a,2c,3,3ka,10,14a,26,30					2				9		1
TCMP	1,2a,2c,3,3ka,10,14a,26,30,B									5		
TCMS	1,2a,2c,3,3ka,10,14a,18,26,30									2		
TCRN	1,2a,2c,3,3ka,10,11,14a,26,30		2					2		6		
TCRS	1,2a,2c,3,3ka,10,11,14a,18,26,30	2	2									
TCRT	1,2a,2c,3,3ka,10,11,14a,18,26,30,B	1		10								
TDBN	1,2a,2c,3,10,14a,24									2		
TDBT	1,2a,2c,3,10,14a,18,24,B	1										
TFBN	1,2a,2c,3,10,14a,24,26									6		
TFMN	1,2a,2c,3,3ka,10,14a,24,26,30									4		
TFRN	1,2a,2c,3,3ka,10,11,14a,24,26,30									4		
TLGJ	1,2a,2c,3,9,11,14a,18			2				18		3	2	
TNBN	1,2a,2c,3,9,10,14a,24									4		
TNMN	1,2a,2c,3,3ka,9,10,14a,24,30					1				7		
TNRN	1,2a,2c,3,3ka,9,10,11,14a,24,30		2							12		
TPGN	1,2a,2c,3,9,10,11,14a,24,26									2		
Number of isolates		14	8	79	2	6	14	26	7	138	8	4
Number of collections		12	4	44	1	5	7	13	4	86	4	3

[1] Race code, see Phytopathology 79:525-529.

[2] Single gene resistances evaluated: *Lr*1,2a,2c,3,3ka,9,10,11,16,17, 18,24,26,30 and new single gene additions evaluated 14a and B.

Table 3. Preliminary oat crown rust survey data for 2000

	Percent virulent	
	AL & FL	TX
Pc 14	94	100
Pc 35	39	93
Pc 36	72	68
Pc 38	78	50
Pc 39	39	50
Pc 40	94	100
Pc 45	17	3
Pc 46	22	25
Pc 48	0	0
Pc 50	6	5
Pc 51	67	80
Pc 52	0	0
Pc 53	0	25
Pc 54	61	20
Pc 55	39	43
Pc 56	61	60
Pc 57	35	33
Pc 58	17	18
Pc 59	28	67
Pc 60	61	90
Pc 61	67	63
Pc 62	0	0
Pc 63	50	45
Pc 64	0	28
Pc 67	89	50
Pc 68	6	3
Pc 70	47	60
Pc 71	39	48
H548	6	5
Dane	28	25
WI-X4361-9	39	40
TAM-O-386R	39	48
TAM-O-393	0	0
B604Xsel	11	23
Vista	0	0
No. isolates	18	40

Fig. 1. Leaf rust severities in wheat fields in 2000

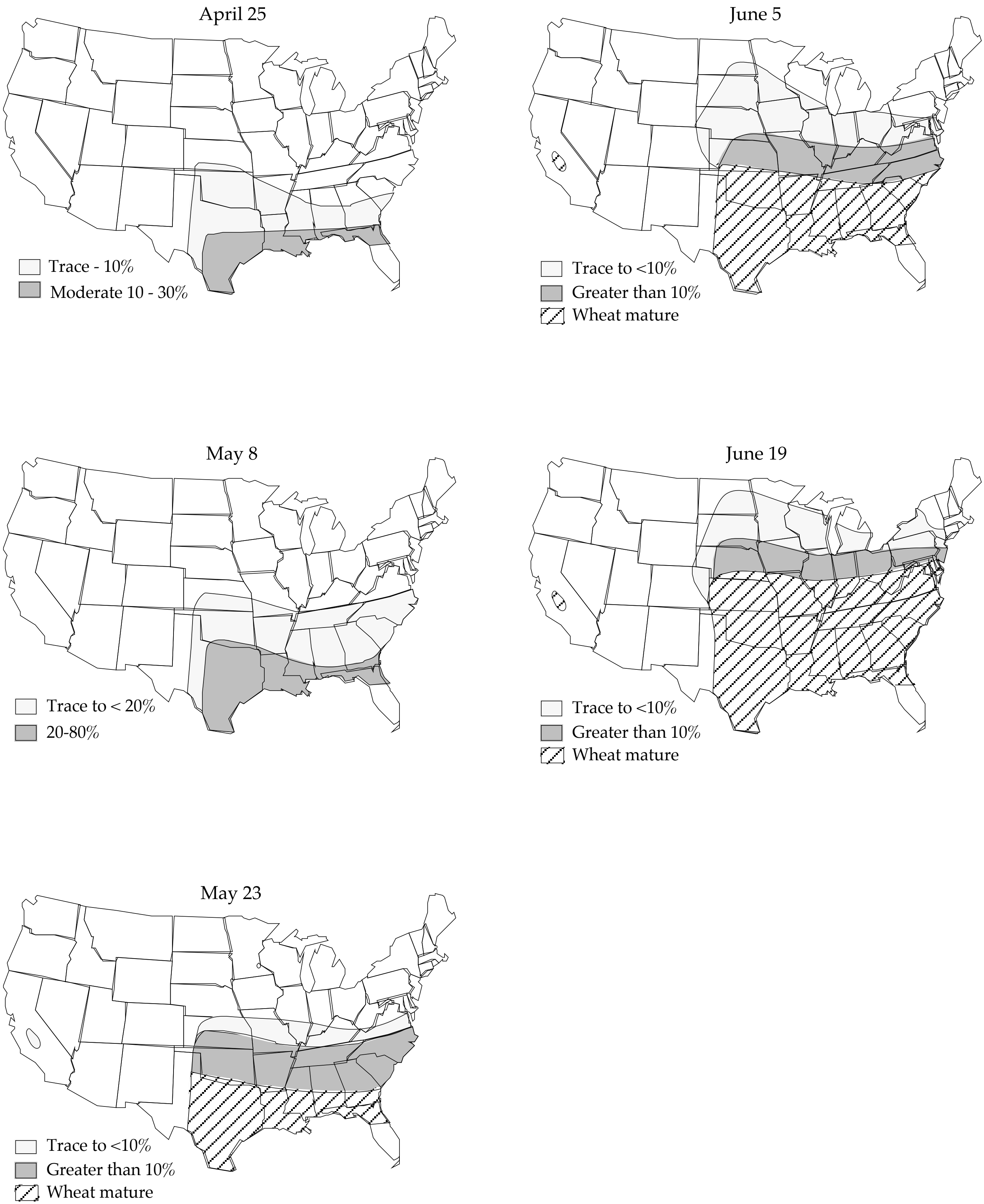
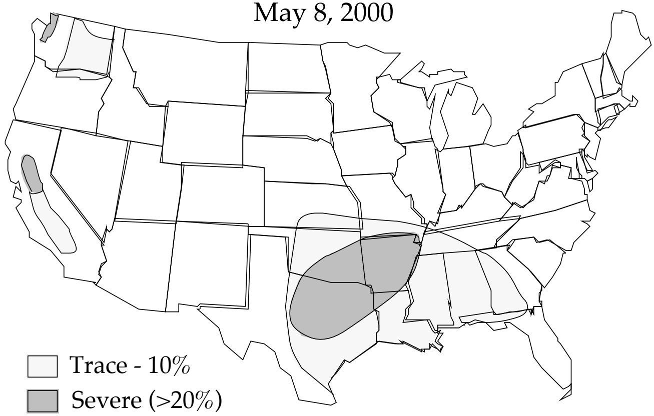


Fig. 2. Stripe rust severities in wheat fields

May 8, 2000



Spread of wheat stripe rust in 2000