

KANSAS COOPERATIVE PLANT DISEASE SURVEY REPORT

2021 KANSAS WHEAT DISEASE LOSS ESTIMATES

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HIGHLIGHTS

The NATIONAL AGRICULTURAL STATISTICS SERVICE September forecast of 364.0 million bushels represented an expected harvest of 7.0 million acres of wheat with an average of 52.0 bushels per acre yield. This is an increase of 6 bushels per acre compared to 2020's harvest, and overall 23.8% increase in harvested bushels statewide. Acres harvested were up 9.4%.

The cumulative disease loss estimate for the 2021 wheat crop was 16.2% or 70.4 million bushels. The potential yield of the crop without diseases was calculated at 434.4 million bushels, or 62.1 bushels per acre.

In 2021, Kansas wheat producers' yields and test weights were decreased as a result of disease pressure. The most important diseases statewide in 2021 were stripe rust (4.2% loss), Fusarium head blight (3.5% loss), and Wheat Streak Mosaic Virus Complex (3.1% loss). All crop reporting districts suffered significant losses but severity of loss due to any specific disease varied between districts due to the variety in crop environment from East to West.

Peaks and valleys which are correlated with weather patterns and disease epidemics mark loss estimates and are based on data collected yearly since 1976 (Figure 1). 2021 was an average year for wheat disease.

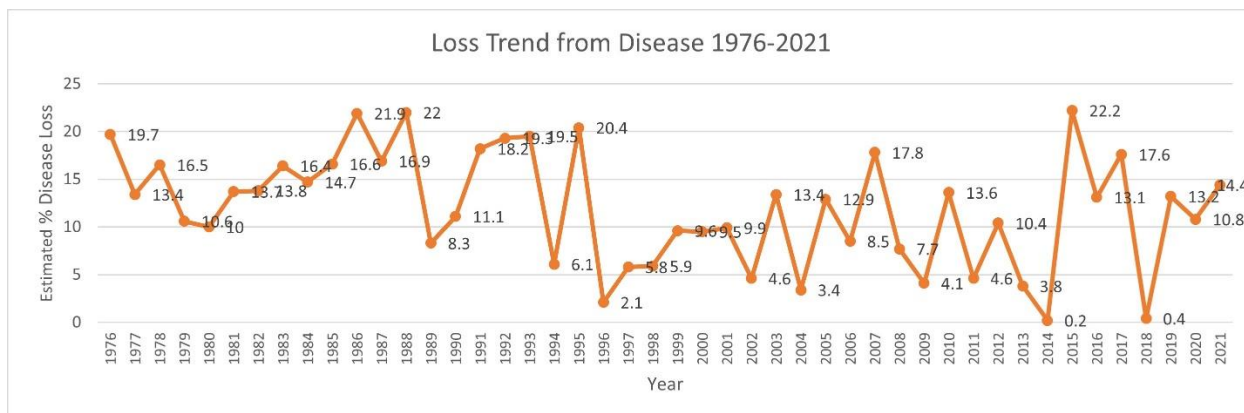


Figure 1. Trend graph of estimated wheat yield loss due to disease from 1976 to 2021, excluding yield loss due to root lesion nematodes. Lesion nematode estimation data were only collected from 2010 to 2015, 2017 to 2019, and 2021, so it was left out for presentation purposes.

DISEASES

The most important disease in wheat in 2021 was **stripe rust**, following a trend of recent years. Percent yield loss this year was 4.2%, which is higher than 2020 (2.9%) and 2018 (0.03%) but lower than 2017 (8.6%) and 2019 (4.6%). It is higher than the 5- and 20-year averages (4.07% and 3.99% respectively) but lower than the 10-year average (5.06%). The large increase compared to 2018 is due to the drought that year, which, unsurprisingly, near-halted disease of all types. Although still a low number compared to most years 2017 and prior, the loss this year was an increase over 2020, of which weather may have been a factor, or other factors such as frequency of fungicide use.

Stripe rust was favored by cool temperatures and very frequent rainfall throughout the spring and summer in 2021. Many of the most commonly-planted wheat varieties in Kansas are susceptible to stripe rust. Stripe rust caused a loss of 16.1 million bushels of wheat statewide.

Stripe rust caused yield loss in all nine crop reporting districts in 2021. In susceptible varieties, the minimum estimated yield loss was 5.0%, in Northwest, West Central, and Southwest districts and the maximum was 21.5%, in East Central district (Figure 2). The Eastern districts were the most heavily affected (although the Central districts were not far behind), while the Western districts suffered the smallest losses.

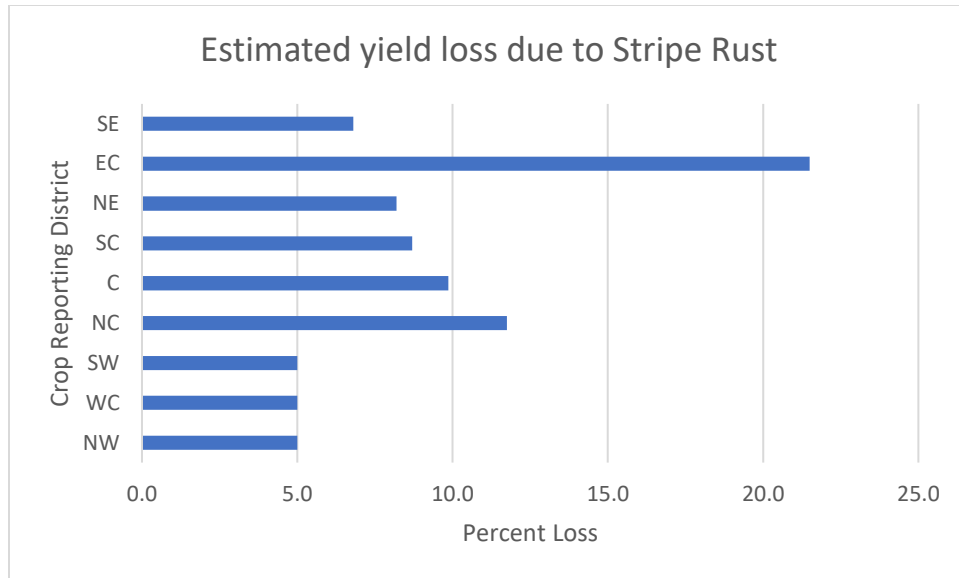


Figure 2. Estimated yield loss due to stripe rust in susceptible varieties ranged from 5.0% to 21.5% in crop reporting districts but was most severe in Central and Eastern districts.

Fusarium head blight (also known as head scab) was the second most important disease of wheat in 2021, with a statewide yield loss of 3.5% or 13.3 million bushels. This was an above-average year for Fusarium head blight, over twice the 5-, 10-, and 20-year averages (1.56%, 1.14%, and 0.74% respectively). It was well above the estimated losses for 2019 and 2020 (2.1% and 1.88% respectively).

Fusarium head blight affected all nine crop reporting districts. It was most damaging in Eastern Kansas this year, although the Central region was close behind, and least damaging in Western Kansas. The losses ranged from 0.5% loss in the Southwest crop reporting districts to 11.3% loss in the Southeast district (Figure 3). It affected the Western crop reporting districts very little but was heaviest in Southeast and Central Kansas. The heavy, frequent rainfall and cooler temperatures throughout spring and into beginning summer are to blame for the spike in losses due to FHB. In addition to yield lost in bushels, this disease, a grain mold, also would have caused losses in the form of dockage at the elevators due to the vomitoxin the fungus produces.

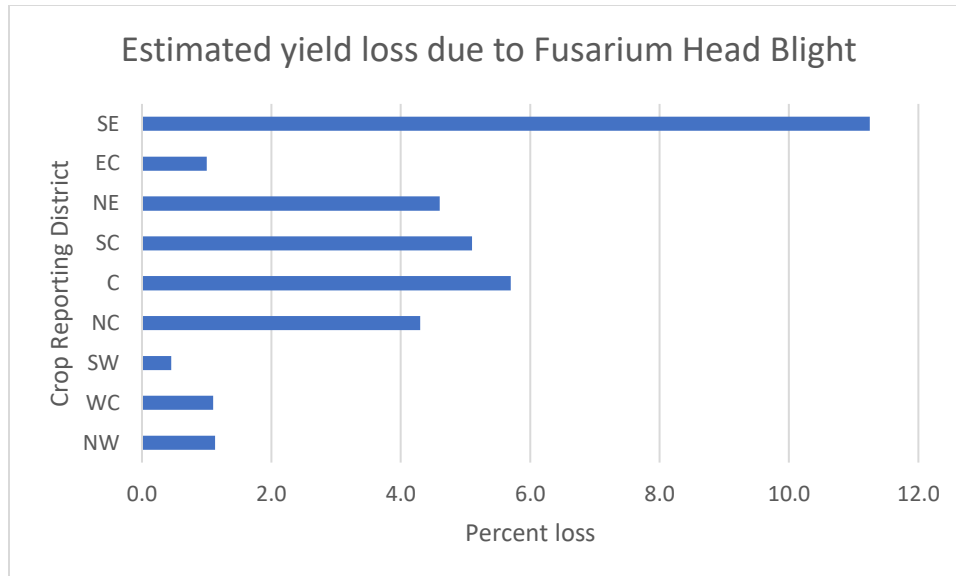


Figure 3. Estimated yield loss due to Fusarium head blight in susceptible varieties ranged from 0.5% to 11.3% in crop reporting districts but was most severe in Southeast and Central districts.

Wheat Streak Mosaic Complex was the third most important disease of 2021, with a statewide estimated yield loss of 3.1%, or 11.6 million bushels. This was an above-average year for Wheat Streak Mosaic Complex, with an estimated loss well above the 5-, 10-, and 20-year averages (1.91%, 1.48%, and 1.39% respectively). This is the highest yield loss due to this disease since 2017, when there was an estimated 5.6% loss, and 2006 prior to that (7% loss).

Wheat streak mosaic virus complex is comprised of wheat streak mosaic virus, transmitted by wheat curl mites, high plains virus, and *Triticum* mosaic virus. The uncharacteristically high estimated loss may have been caused in part by heavy germination of volunteer wheat in late summer and early fall 2020. This would have created a “green bridge” upon which the wheat curl mite was able to survive between 2020 harvest and 2021 planting. It would have then been able to wreak havoc on the planted winter wheat crop.

WSM caused yield loss in 6 of 9 crop reporting districts, ranging from 0% in each of the Eastern districts to 8.3% in Central district (Figure 4). Losses were negligible in the Eastern districts compared to in the West due to much less of a conducive environment for growth and spread of WSM.

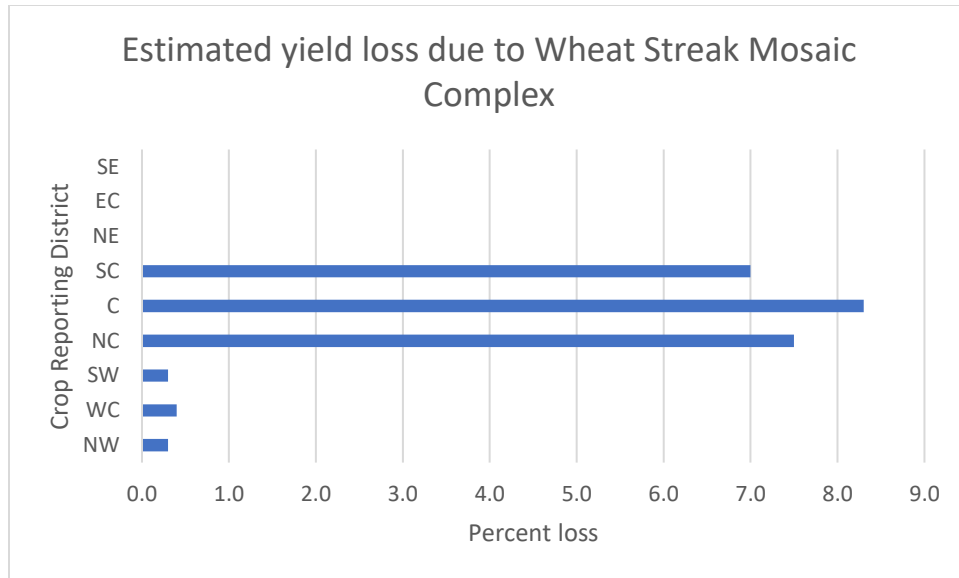


Figure 4. Estimated yield loss due to wheat streak mosaic virus in susceptible varieties ranged from 0% to 8.3% in crop reporting districts but was most severe in Western districts.

Tan spot had a 2.16% estimated loss in 2021, or about 8.0 million bushels. This yield loss was above the 5-, 10-, and 20-year averages for tan spot (1.26%, 0.78%, and 0.62% respectively). Tan spot was most prevalent in Eastern and Central Kansas, while less common in the West.

Other diseases of interest in 2021 were **leaf rust** (0.32% estimated loss), **Septoria complex** (0.2% estimated loss), **barley yellow dwarf virus** (0.25% estimated loss), **bunt and loose smut** (0.5% estimated loss), and **bacterial leaf complex** (0.05% estimated loss). A **Karnal bunt** survey was also conducted post-harvest in 2021. Karnal bunt was not detected in Kansas. This survey has been conducted yearly since 1993 with no positive finds.

Root lesion nematode data collection continued in 2021 after a one-year absence in 2020 due to COVID-19-related restrictions. Thirty fields were sampled across 16 counties in Central and Western Kansas for nematode populations (Figure 5). Estimated yield loss due to root lesion nematode was 1.8% or 6.7 million bushels. This near-but-slightly-above-average level of losses is likely because the nematodes are already established in the safety of the soil and were therefore less affected by any change in weather conditions, and generally their populations do not fluctuate to the degree that foliar diseases do. It could be slightly above average because of the randomness of sampling. The estimate compares to a 5-year average of 1.45% and a 10-year average of 1.76%.

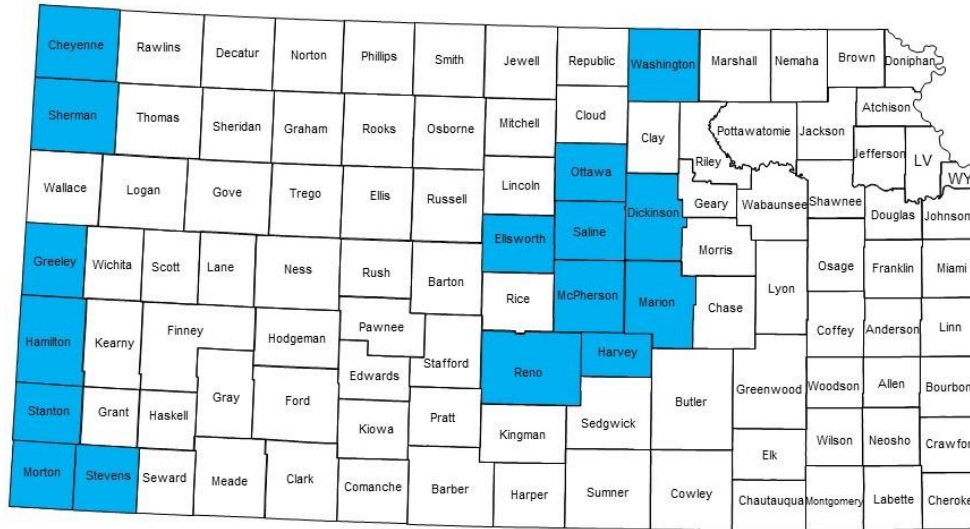


Figure 5. The 22 counties targeted in the 2021 wheat root lesion nematode survey.

The yield loss table from the past 20 years shows how each year is unique (Figure 6). Factors such as weather, crop rotation, variety selection, and cultural practices can all have a significant impact on which diseases may thrive and which may be suppressed in any given year. Stripe rust continues to be the most important wheat disease in Kansas, having surpassed leaf rust in recent years due to introduction of a new race of the pathogen capable of tolerating the hotter temperatures of the Great Plains.

2013	2014	2015	2016	2017	2018	2019	2020	2021	5-YR AVE	10-YR AVE	20-YR AVE	DISEASE
0.03	0	15.4	9.1	8.6	0.03	4.6	2.87	4.24	4.07	5.06	3.99	STRIPE RUST
0.01	0.001	0.5	1.3	0.8	0.22	3	2.82	0.32	1.43	1.00	1.84	LEAF RUST
1.2	0.05	2.7	0.05	5.6	0.07	0.3	0.5	3.08	1.91	1.48	1.39	WHEAT STREAK MOSAIC COMPLEX
0.25	0.001	0.001	1.3	0.9	0.001	0.001	0.1	0.25	0.25	0.51	0.56	BARLEY YELLOW DWARF
0.5	0.1	0.01	0.9	0.9	0.001	1.6	1.63	2.16	1.26	0.78	0.62	TAN SPOT
1.7	0	0.1	0.3	0.4	0.001	1.4	0.64	0.2	0.53	0.48	0.48	SEPTORIA COMPLEX
0.05	0.02	3.4	0.1	0.3	0	2.1	1.88	3.53	1.56	1.14	0.74	SCAB
0.01	0.001	0.01	0	0	0	0.1	0.001	0.01	0.02	0.01	0.02	SOILBORNE & SPINDLE STREAK
0.01	0.001	0.001	0.05	0.05	0.02	0.01	0.01	0.01	0.02	0.02	0.08	POWDERY MILDEW
0.01	0.01	0.001	0	0	0.06	0.01	0.05	0.001	0.02	0.02	0.03	ROOT & CROWN ROT
0.01	0.001	0.001	0.01	0.01	0.001	0.001	0.3	0.5	0.16	0.09	0.05	BUNT, LOOSE SMUT, FLAG SMUT
0	0.001	0	0	0	0	0	0.01	0.001	0.00	0.00	0.01	TAKE-ALL
0	0	0	0	0.01	0	0	0	0	0.00	0.00	0.00	STRAWBREAKER
0.03	0.01	0.03	0	0	0.03	0.05	0.03	0.05	0.03	0.03	0.02	BACTERIAL LEAF COMPLEX
0	0.001	0.001	0	0	0.001	0.01	0	0	0.00	0.00	0.00	STEM RUST
0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	SNOW MOLD*
0	0.001	0	0	0	0	0	0	0	0.00	0.00	0.00	CEPHALOSPORIUM STRIPE

0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	AMERICAN WHEAT STRIATE*
2.4	1.0	2.6	-	0.6	2.0	1.4	-	1.8	1.45	1.76	1.77	LESION NEMATODES*
3.8	0.2	22.2	13.1	17.6	0.4	13.2	10.8	14.4	11.3	10.6	9.8	TOTAL

Figure 6. Yield loss estimates from Kansas production 2013-2021 with 5-, 10-, and 20-year averages.

- Estimates were prepared by Kansas State University, Kansas Department of Agriculture, and USDA-ARS personnel. Estimates are based on expert opinions, not statistically designed.
- Estimates use a disease survey, variety resistance, variety acreages, crop district yield estimates, and loss functions for each disease. NASS/Kansas Agricultural Statistics provided information for variety acreages and crop district yield estimates.
- Special thanks to the staff at the Great Plains Diagnostic Laboratory, Kansas State University, and the Plant Protection & Weed Control program, Kansas Department of Agriculture, for their aid in surveying and disease diagnosis. Without their contributions, this paper would not be possible.
- *Lesion nematode estimates were begun in 2008-2010. The 2010 estimate is an average based upon 3 years of sampling. In total, over 2100 fields at a rate of 1 location/sample (2-3 acres) per 4800 acres of planted production acreages per county (NASS) were taken over the three-year period. After 2010, a preservation survey based upon a small number of samples (25-30/state annually) has been used for loss estimates to extend the 2008-2010 foundation survey. No data were collected in 2016 or 2020.