Monitoring Stripe Rust in Cereal Crops

SUMMARY

During 2021 growing season, a total of 90 plant samples were collected from wheat, barley, and oat fields in seven counties. Due to relatively dry winter and spring, stripe rust was not detected on durum wheat and barley across the state. High incidence of barley loose smut occurred in several fields in Buckeye, Maricopa. Seedborne fungus *Pyrenophora graminea* was detected in 3 barley samples from Maricopa. Extensive leaf blight caused by several fungi including *Alternaria*, *Stemphylium*, and *Curvularia* was observed in several fields in Maricopa and Pinal. Two *Pythium* species were detected in wheat and oat showing symptoms of stunting. The presence of seedborne *Pyrenophora graminea* and prevalence of leaf blight may contribute to yield suppression. Strategies for fungal disease management such as seed treatment will be needed to improve the wheat and barley yield.

MATERIALS AND METHODS

Sample collection. Samples of wheat, barley, and oat were collected from commercial fields in 7 Arizona counties between November 2020 to May 2021 (Table 1). The selected sites had visible symptoms of yellowing, leaf tip dieback, leaf spots, striping, and stunting. Multiple samples ranging from 2 to 15 were collected from each site.

Isolate derivation and identification. Plant tissues were surface sterilized and isolations were carried out using PARP, PDA, APDA, WA media. Isolate identification was based on morphological characteristics and bidirectional sequencing of ITS region of the ribosomal DNA of each isolate.

RESULTS & DISCUSSIONS

A total of 90 plant samples were collected from wheat, barley, and oat fields in seven counties including Yuma (8), La Paz (2), Maricopa (26), Pinal (34), Pima (8), Cochise (5), and Graham (7).

Stripe rust was not detected in any of the commercial fields we visited between November 2020 and May 2021. The absence of stripe rust was due largely to warm winter and spring and the below average rainfall during winter and early spring. According to stripe rust update from USDA ARS Laboratory of the Wheat Genetics, Physiology, Quality, and Disease Research Unit at Pullman, WA, wheat stripe rust was first detected in in western Washington and Louisiana in January 2021. By March, it has been reported so far in Louisiana, Texas, and Oklahoma. By May, wheat stripe rust has been reported in twelve states (Louisiana, Texas, Washington, Oklahoma, Tennessee, Arkansas, California, Oregon, Mississippi, Kansas, Nebraska, and Ohio). Barley stripe rust has been reported in Washington, California, and Oregon. Overall, the stripe rust pressure in Washington and California was very low. This is the lowest stripe rust level of this time of year over the last many years in Washington.

Loose smut was detected on barley and oat. High incidence of barley loose smut occurred in several commercial fields in Buckeye. The "smutted" grain heads, which contain masses of black or brown spores, were visible in affected fields (Fig. 1). Teliospores were collected and DNA was extracted. Based on the derived ITS sequence from teliospores, *Ustilago nuda* and U. avenae are confirmed as the fungi associated with loose smut of barley and oat, respectively.

BYDV was not detected in any of the 14 samples. These samples were collected from plants exhibiting yellow stripes and was thought to be due to barley yellow dwarf virus (BYDV). Both PCR and serological tests were performed, Iron deficiency, zinc deficiency, and herbicides injuries can cause similar symptoms of stripes.

Pyrenophora graminea was detected in 3 barley samples from Maricopa. This fungus is specific to barley and causes striping symptoms on leaves (Fig. 2). This disease is seedborne and has been reported in more than 17 states. However, this is the first report of *P. graminea* in Arizona. The morphology of *P. graminea* (Fig. 3) and its ID has been confirmed by ITS sequences. The extent of barley striping infection in commercial fields is unknown and a further survey on infection by *P. graminea* is needed.

Extensive leaf blight was observed in many fields in Maricopa and Pinal. Dark brown elliptical spots developed on lower leaves and spread later to upper leaves. These dark spots enlarge and coalesced with adjacent spots to have leaf blight appearance (Fig. 4). Some yellowing of the area surrounding the dark spots. Severely affected leaves die (Fig. 4). A total of 52 fungal isolates belonging to the genus of Pleosporales were recovered (Fig. 4). According to DNA sequencing results, The IDs of these recovered isolates were *Alternaria alternata*, *Stemphylium vesicarium*, *Cuvularia*, *Exserohilum rostratum*, and *Cladosporium allicinium* (Fig. 5). *A. alternata* is known to produce tenuazonic acid. *Cladosporium* can cause soot mold on head. Under humid conditions, these pathogens may cause extensive damages. Seed treatment with fungicides may help reduce the incidence of leaf blight.

Pythium aphanidermatum and *P. spinosum* were recovered from young plants of wheat and oat showing symptoms of stunting (Fig. 6). It is highly likely that some of these fields may have experienced prolonged soil waterlogging. These two *Pythium* species have been reported as pathogens in wheat in North Carolina (Reeves et al. 2021). They are not opportunistic or mainly saprophytic on other hosts and contributed to the extreme stunting and root loss observed in North Carolina wheat in 2016.

We have provided timely diagnostic support for our growers and pest control advisors. During 2020-2021 growing season, we have made several farm visits to assist growers for disease identification. More than Thirteen cotton disease specimens have been submitted to the extension plant pathology lab for pathogen analysis. These project activities have greatly engaged our growers to address their wheat production problems in a timely manner.

Table 1. Pathogens and diseases detected from wheat, barley and oat samples

Pathogens	Diseases	County (No. of isolates or samples)
Puccinia striiformis f.sp. *tritici*	Wheat stripe rust	Not detected
Puccinia striiformis f.sp. *hordei*	Barley stripe rust	Not detected
Ustilago nuda	Barley loose smut	Maricopa (6)
Ustilago avenae	Oat loose smut	Yuma (1), Pinal (2)
Pyrenophora graminea	Barley/wheat striping	Maricopa (9)
Stemphylium vesicarium	Barley leaf blight	Maricopa (6), Pinal (13)
Exserohilum rostratum	Barley leaf blight	Maricopa (6), Pinal (13)
Alternaria sp.	Barley leaf blight	Maricopa (6), Pinal (13)
Cuvularia sp.	Barley leaf blight	Maricopa (6), Pinal (13)
Cladosporium allicinium	Barley leaf blight	Maricopa (6), Pinal (13)
Pythium aphanidermatum	Stunted wheat/barley/oat	Yuma (2), Pinal (4), Cochise (2)
P. spinosum	Stunted wheat/barley/oat	Yuma (2), Pinal (4), Cochise (2)

P. vanterpoolii	Stunted wheat/barley/oat	Pinal (1), Graham (1)
BYDV	Barley yellow dwarf virus	Not detected (14)

REFERENCES

Reeves, E. R., Kerns, J. P., Cowger, C., and Shew, B. B. 2021. Pythium spp. Associated with Root Rot and Stunting of Winter Wheat in North Carolina. Plant Dis 105:986-996.

Fig. 1. Barley loose smut caused by *Ustilago nuda*

Fig. 2. Barley stripes caused by *Pyrenophora graminea*

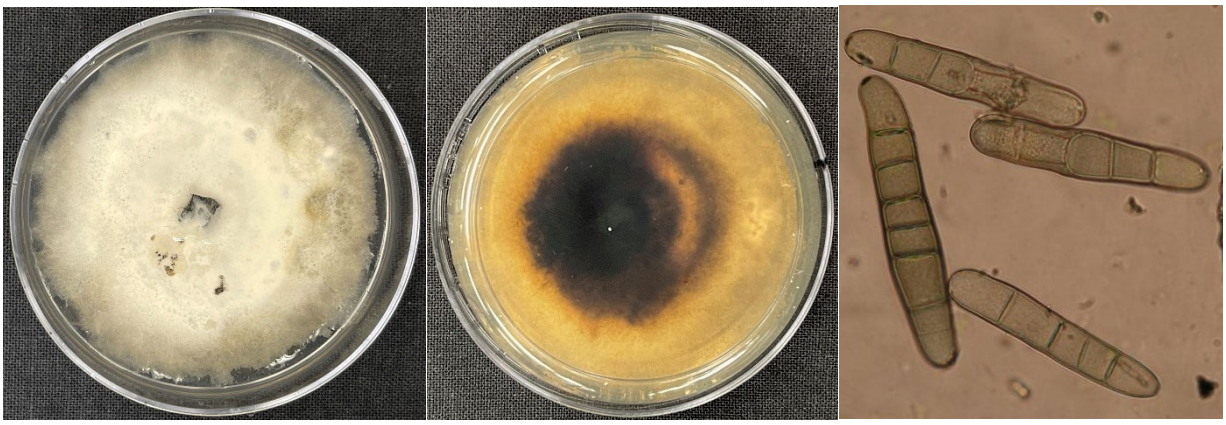
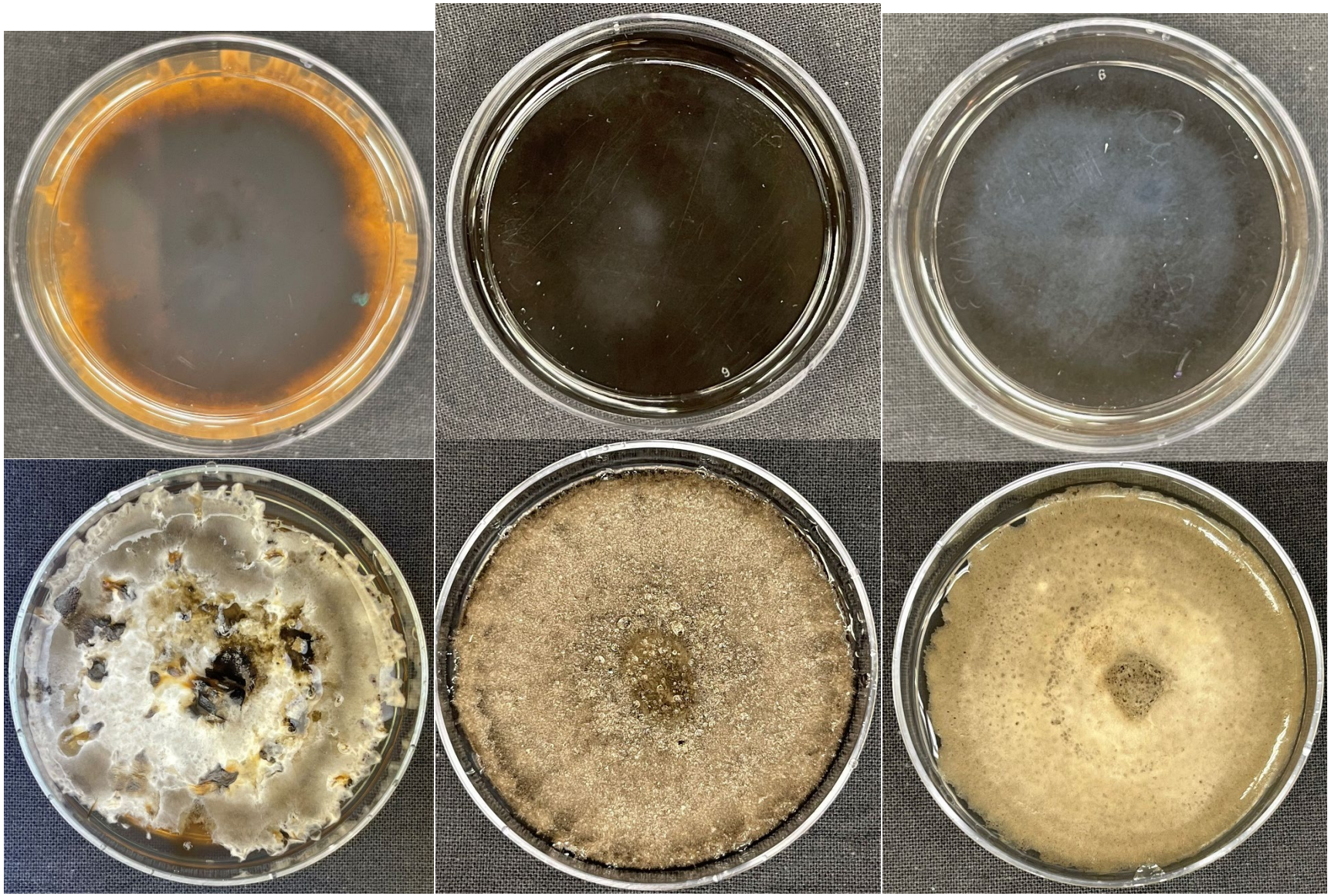


Fig. 3. Colony morphology of *P. graminea* (2-month-old PDA culture)

Fig. 4. Leaf blight of barley in Maricopa and Pinal



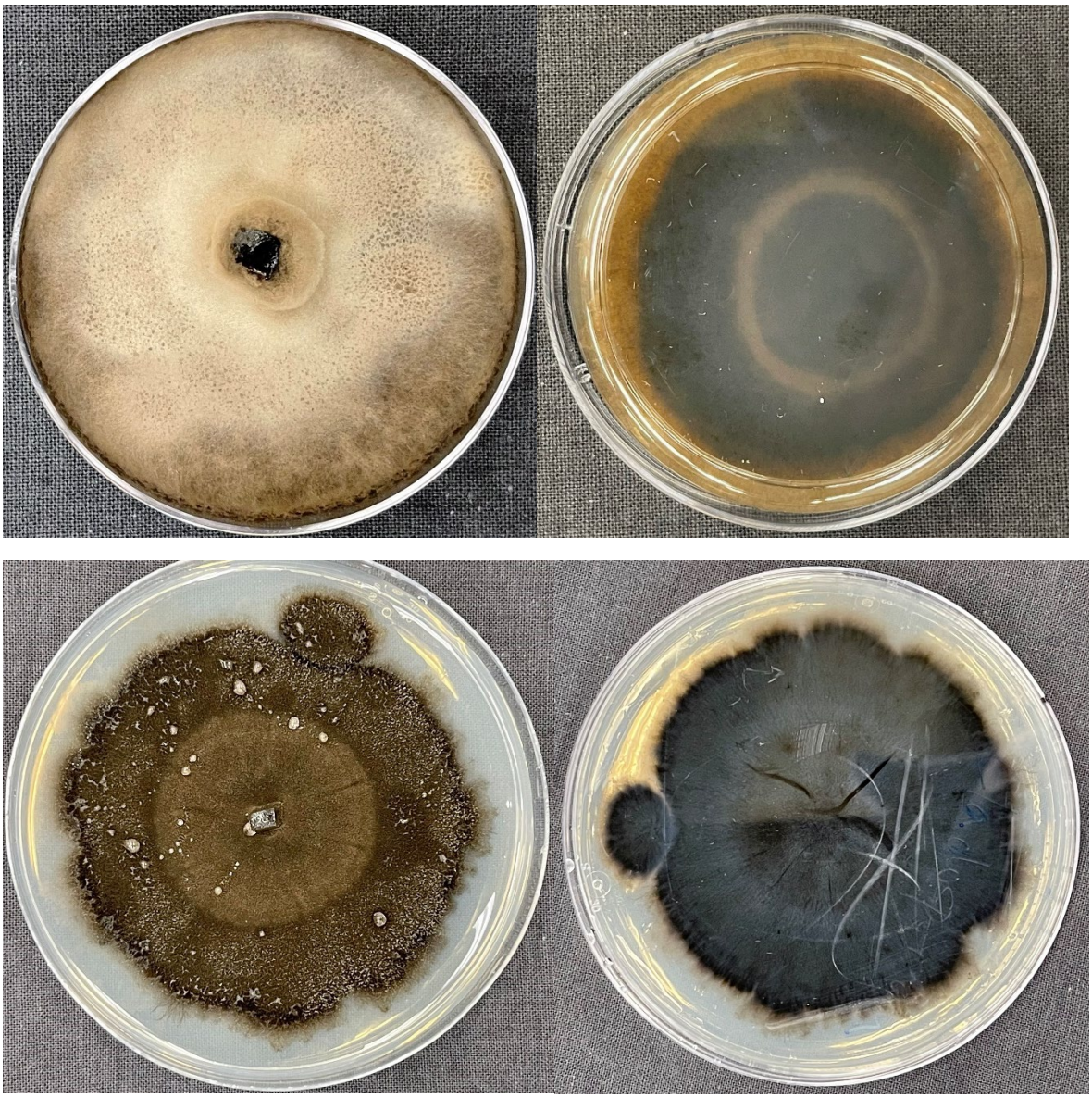


Fig. 5. Colony morphology of *Stemphylium vesicarium, Alternaria*, *Cuvularia*, *Exserohilum rostratum*, and *Cladosporium allicinium* (2-month-old PDA culture)

Fig. stunting and leaf striping of oat

Supplemental materials

Ustilago nuda: ITS

TCGTAACAAGGTATCTGTAGGTGAACCTGCAGATGGATCATTTCGATGAAAAACCTTTTTTCAGAGGTGTGGCTCG
CACCTGTCCAACTAAACTTGAGCTACCTTTTTCAACACGGTTGCATCGGTCGGCCTGTCAAACAGCGCGACGCAAG
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TACTATCAGGACTTCGGAGAGGTTGAGATGGGTAGGAGCTCGACGCAACGGCTTGCTGTTTGGAGTGCTTCTGAA
ACCCGCCCATGCCGAGTTTTCTTTTAGAAAGCTAGGAAGGAATTTATAATAATTCATCGGCCTCAGATTGGTAGGA
CTACCCGCTGAACTTAAGCATATCAATA

Pythium aphanidermatum: ITS

GCGGAAGGATCATTACCACACCATAAAAACTTTCCACGTGAACCGTTGTAATCATGTTCTGTGCTYTCTTTCGGGAG
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Pythium spinosum: ITS

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