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PASCAL ROSSIGNOL/REUTERS

Wheat crops in Europe — the world's largest wheat-producing region — have not been seriously troubled by stem-rust fungi since the 1950s.

AGRICULTURE

Wheat rust back in Europe

New variety of stem-rust fungus devastated Sicilian crops last year — and could spread.

BY SHAONI BHATTACHARYA

An infection that struck wheat crops in Sicily last year is a new and unusually devastating strain of fungus, researchers say — and its spores may spread to infect this year's harvests in Europe, the world's largest wheat-producing region.

"We have to be careful of shouting wolf too loudly. But this could be the largest outbreak that we have had in Europe for many, many years," says Chris Gilligan, an epidemiologist at the University of Cambridge, UK, who leads a team that has modelled the probable spread of the fungus's spores.

In alerts released on 2 February, researchers revealed the existence of TTTTF, a kind of stem rust — named for the characteristic brownish stain it lays down as it destroys wheat leaves and stems. The alarm was raised by researchers at the Global Rust Reference Center (GRRC), which is part of Aarhus University in Denmark, and the International Maize and Wheat Improvement Center (CIMMYT), headquartered in Texcoco, Mexico.

The new strain came to light after it destroyed tens of thousands of hectares of crops in Sicily last year. What's particularly troubling, the researchers say, is that GRRC tests suggest the pathogen can infect dozens of laboratory-grown strains of wheat, including hardy varieties that are usually highly resistant to disease. The team is now studying whether commercial crops are just as susceptible.

Adding further concern, the centres say that two new strains of another wheat disease, yellow rust, have been spotted over large areas for the first time — one in Europe and North Africa, and the other in East Africa and Central Asia. The potential effects of the yellow-rust fungi aren't yet clear, but the pathogens seem to be closely related to virulent strains that have previously caused epidemics in North America and Afghanistan. The Food and Agriculture Organization of the United Nations (FAO) ▶

in Rome issued similar alerts about the three diseases on 3 February.

Severe wheat damage in Europe could affect food prices, inflation and the region's economic stability, says James Brown, a plant pathologist at the John Innes Centre in Norwich, UK. But researchers hope that by putting out alerts before European wheat crops have started to grow this year, they will give farmers enough warning to monitor fields and apply fungicides, halting the disease's spread. Plant breeders can also start to ramp up efforts to produce resistant varieties. "Timely action is crucial," says Fazil Dusunceli, a plant pathologist at the FAO.

In the mid-twentieth century, devastation caused by stem rust spurred efforts to breed wheat strains that could resist the fungi. That research — led by agronomist Norman Borlaug — famously led to the Green Revolution in agriculture, increasing crop yields around the world.

But stem rust returned in the late 1990s and 2000s, with a variety called Ug99 that spread through Africa and parts of the Middle East. It ruined harvests and caused international concern because, says Dusunceli, more than 90% of wheat crops were susceptible to it. So far, however, it hasn't hit large wheat-producing regions such as Europe, China and North America. Researchers are developing resistant crops.

Stem-rust epidemics haven't been seen in Europe since the 1950s, says Mogens Hovmøller, who leads the GRRC's testing team. But the outbreak that hit Sicily in 2016 suggests that the disease has now returned.

S. TVEDEN-NYBORG & M. PATPOUR/AARHUS UNIV.

TTTTF stem rust leaves a brown stain on wheat.

Unusually, even the hardy durum wheat, used to make pasta, is susceptible to it, says Hovmøller. But it's too early to say whether the new infection could be as devastating as Ug99.

Models based on wind and weather patterns, conducted by Gilligan's team at Cambridge together with CIMMYT and the UK Met Office in Exeter, suggest that stem-rust spores released during the Sicilian outbreak may have been deposited throughout the Mediterranean region. That doesn't mean the infection will spread — the spores may not have survived the winter, for example — but it is worrying enough for researchers to raise the alarm.

The yellow-rust strains are also a concern, says Hovmøller. For Europe, perhaps the most alarming is one provisionally called Pst(new), which was spotted in Morocco and Italy and northern Europe in 2016. The fungus is related to a virulent strain that hit North America in the 2000s, but it is not clear how aggressive it is.

Researchers are accustomed to finding one or two new wheat-rust strains each year in Europe; these must be guarded against but are not usually dangerously virulent. But since 2010, the region has experienced a greater influx of wheat pathogens, says Hovmøller. He doesn't know why, but speculates that it could be down to warmer autumns and milder winters attributable to climate change, along with changes in farming practices, such as sowing wheat earlier in the year. Increased international travel — potentially spreading spores on clothing — could also be a factor, says Brown.

Hovmøller and others will in the next few weeks ask the European Research Council for funds to establish an early-warning system. That will help partners including breeders, scientists and agrochemical companies in Europe to share diagnostic facilities and information about potential outbreaks. Dusunceli thinks that such a network might have helped to mitigate the Sicily outbreak, which in turn would have meant that fewer spores could spread to other parts of the continent. "I wouldn't question the necessity for an early-warning system," he says. ■

GRAVITATIONAL WAVES

Underdog lab is ready to roll

It missed the historic discovery, but the Virgo gravitational-wave detector in Italy is now primed to extend LIGO's reach and precision.

BY DAVIDE CASTELVECCHI

The car journey along the gravitational-wave detector's right arm lasts a good 10 minutes, an eternity compared with the 10 microseconds it takes for the laser light needed to detect these ripples in space-time to make the same trip.

This tunnel isn't in Hanford, Washington, or Livingston, Louisiana, the locations of the twin labs that form the Laser Interferometer Gravitational-Wave Observatory (LIGO), which made history a year ago when its team announced the first direct detection of gravitational waves.

This is LIGO's lesser-known cousin Virgo, a gravitational-wave lab that uses similar equipment and lies in the bucolic Tuscan flatlands near Pisa in Italy.

Virgo began hunting gravitational waves in 2007. LIGO came online in 2002 and made its first discovery — of waves produced by the merger of two black holes — in September 2015, leading to the announcement on 11 February 2016. Virgo was being upgraded and missed the event, a source of quiet disappointment. "Let's be honest, it will be the Americans who will get the Nobel," says Luciano Maiani, a particle physicist at the Sapienza University of Rome. Maiani headed Italian funding agency the INFN in the 1990s, when it gave Virgo the go-ahead along with the CNRS, France's basic-research agency.

Now, the 5-year, €23-million (US$24 million) 'Advanced Virgo' overhaul is almost finished: the upgraded lab will be inaugurated on 20 February, although it will be several more weeks before it starts doing science. Together, the twin LIGO machines and Virgo will make more-detailed and more-confident detections than LIGO alone. "We're happy to have an instrument that's starting to come back to life," says physicist Bas Swinkels, who is coordinating the Virgo tune-up.

LIGO's September find, combined with one it made on 25 December 2015, suggest that gravitational-wave detections will occur regularly. This validates the whole enterprise and opens up the field of gravitational-wave astronomy that Virgo helped to pioneer.

"After the announcement, we felt vindicated," says Giovanni Losurdo, who has worked at Virgo since the early 1990s and led the overhaul project. "All the work we did for nearly 30 years in near-obscurity suddenly gained a meaning."