Global warming and China's crop pests

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A new dataset that comprises more than 5,500 historical crop pest and disease records in China provides a unique opportunity to understand how climate affects crop pest and disease outbreaks.

More than 2,000 years ago, officials of the Han Dynasty began systematically recording Oriental migratory locust (*Locusta migratoria manilensis*) outbreaks in eastern China[1] (Fig. 1). Continued and expanded by subsequent administrations, these records stand as the world's longest time-series of crop pest outbreaks and provide ecologists with a unique resource to investigate questions such as the relative importance of biotic and climatic factors in driving insect population dynamics[1,2]. As the world warms, records of crop pest and disease (hereafter, CPD) distributions and impacts have become a key tool in understanding how climate change could affect global food security[3], yet such records are biased and incomplete for much of the planet[4]. Now, writing in Nature Food, Wang and colleagues present a historical dataset of crop area affected by CPD across China, filling an important gap in our understanding of biotic threats to food security[5].

Fig. 1: China's long history of crop pest and pathogen monitoring. Chinese Imperial civil servants, here seen sitting an examination, began recording migratory locust outbreaks nearly two millenia

ago. The publication of CPD occurrences by Wang and colleagues5 provides further understanding of pressures on food production and new insight into climate change impacts.
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Perhaps the most comprehensive global dataset on CPD distributions is that compiled by the Centre for Agriculture and Bioscience International (CABI), which has been abstracting information on observations of species affecting agricultural production from the scientific and 'grey' literature for many decades[6]. These distribution records have been analysed extensively to reveal global patterns and trends in the burden of CPD to agriculture[3,7]. However, there are issues with this dataset. The probability of a CPD being listed as present in a particular country or subnational region is strongly biased by the scientific and technical capacity of countries to detect, identify and report a presence4. Hence, CPD reporting from countries with relatively low rates of scientific publication (often in the Global South) is less likely than from countries with strong scientific capacity. High production levels of a diverse range of crops suggest that China should harbour the greatest number of CPDs, yet relatively few are present in CABI databases because Chinese CPD records were formerly inaccessible[4]. Following the reopening of the country in 1978, Chinese scientific research has accelerated rapidly and the publication of CPD distributions is a welcome corollary of this scientific renaissance[5].

The dataset presented by Wang and colleagues comprises more than 5,500 CPD survey records compiled by the National Agricultural Technology Extension and Service Center (NATESC) from 1970 to 2016. Wang and co-workers took estimated CPD occurrence areas aggregated to province level, and divided them by the areas under production of different crops to give an aggregate index, Or, of the relative area affected per crop per year by all recorded CPDs. Overall, the most important CPD groups by occurrence area were Lepidoptera (37% of total), Homoptera (22%) and Fungi (28%), and the most affected crops were rice (48%), wheat (26%) and maize (17%). Host crops other than the major grains comprised less than one-tenth of the area affected. Overall Or increased from an average of 53% to 218% of cropland area over the study period and is greatest in the major production regions of the North China Plain and the Middle and Lower Yangtze Plains.

Anthropogenic global warming is shifting mean temperature isoclines poleward, and large-scale analyses indicate that CPD distributions have followed temperatures and will continue to do so[3,8,9]. The NATESC data provide a unique opportunity to understand climate impacts on CPD outbreaks in one of the most important crop producing countries. Wang and colleagues detrended both Or and predictor variables to avoid spurious correlations due to extraneous long-term trends before investigating the contributions of climate and management to CPD occurrence. They found the strongest correlation of Or with night-time temperature, followed by frost day frequency. Daytime temperatures were also important, but this varied considerably by province. In contrast, precipitation had a weaker overall correlation, with high spatial variability. Although moisture is known to be an important driver of some CPD lifecycles, the dominance of temperature over precipitation echoes other modelling[8] and observational studies[10]. Other climatic variables (for example, relative humidity) and management factors (for example, fertilizer and pesticide application rates) were weakly correlated with Or anomalies. Using the observed climate correlations, Wang and colleagues calculated future Or from climate projections under two emissions scenarios, estimating that CPD occurrence could increase to an average of between 246% and 460%.

Although the NATESC data are limited by geographical and species aggregation, and are biased towards those species that have caused substantial damage in the past (rather than noting the occurrence of any CPD), they nevertheless provide researchers with new insights into agriculture and food security in the world's most populous nation. Fluctuations in China's agricultural production and demand are a growing influence on the global food system. Historically, China has tended not to sell grain on global commodity markets, but can have major price impacts when it does[11]. Likewise, recent high demand for animal feed in China sent global grain prices soaring. Hence, the rapid growth in the crop production area affected by CPDs revealed by Wang and colleagues has implications for us all.

References

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