Application of neural networks to image recognition of wheat rust diseases.

Rust diseases of cereals are caused by pathogenic fungi and can significantly reduce plant productivity. Many cultures are subject to them. The disease is difficult to control on a large scale, so one of the most relevant approaches is crop monitoring, which helps to identify the disease at an early stage and make efforts to prevent its spread. One of the most effective methods of control is the identification of the disease from digital images that obtained by a smartphone camera.

In wheat, the most important agricultural crop, one of the most common diseases is diseases caused by pathogenic fungi, which include leaf and stem rust. As a result of diseases, there may be a decrease or complete yield loss. To combat these diseases, effective monitoring of crops is necessary, which would allow a rapid response to the appearance and development of the disease. This monitoring can be achieved using an image recognition model that can detect wheat rust, allowing a crowdsourcing approach to crop monitoring, using features such as social networks and images obtained by mobile devices. The solution to this problem represents a potential breakthrough in our ability to predict, track, and control plant diseases.

<https://ieeexplore.ieee.org/document/9214703>

@INPROCEEDINGS{9214703, author={M. {Genaev} and S. {Ekaterina} and D. {Afonnikov}}, booktitle={2020 Cognitive Sciences, Genomics and Bioinformatics (CSGB)}, title={Application of neural networks to image recognition of wheat rust diseases}, year={2020}, volume={}, number={}, pages={40-42}, doi={10.1109/CSGB51356.2020.9214703}}

Aerial Visual Perception in Smart Farming: Field Study of Wheat Yellow Rust Monitoring.

Agriculture is facing severe challenges from crop stresses, threatening its sustainable development and food security

Wheat is the most widely grown crop in the world, providing 20% of protein and food calories for 4.5B people. Its demand is also increasing with a growing world population (60% more by 2050 with a predicted population of 9B). However, wheat production is now facing a number of challenges from abiotic stresses, pathogens and pests due to climate changes. Among them, wheat yellow (or stripe) rust, caused by Puccinia striiformis f. sp. tritici (Pst), is a devastating wheat disease worldwide, particularly in regions with temperate climates [6]. This disease develops and spreads very quickly under favourable environmental conditions such as a temperature of 5-24oC, a moderate precipitation in spring. It is estimated that yield loss caused by yellow rust disease is at least 5.5 million tons per year at a global level.

<https://ieeexplore.ieee.org/document/9027887>

@ARTICLE{9027887, author={J. {Su} and D. {Yi} and B. {Su} and Z. {Mi} and C. {Liu} and X. {Hu} and X. {Xu} and L. {Guo} and W. {Chen}}, journal={IEEE Transactions on Industrial Informatics}, title={Aerial Visual Perception in Smart Farming: Field Study of Wheat Yellow Rust Monitoring}, year={2020}, volume={}, number={}, pages={1-1}, doi={10.1109/TII.2020.2979237}}

**Vertical features of yellow rust infestation on winter wheat using hyperspectral imaging measurements.**

Yellow (stripe) rust Puccinia striiformis has caused severe losses on wheat in yield and grain quality in China. As the largest land area devoted to wheat production, China has also the largest area prone to yellow rust epidemics.

Wheat yellow (stripe) rust caused by Puccinia striiformis f. sp. tritici (PST) is one of the most devastating diseases of wheat worldwide [1]. In China, yellow rust has appeared in yearly epidemics since the widespread occurrence of the disease in the 1950s and has caused losses of more than 60 million tons [2]. Severe levels of infection can cause yield losses of more than 50% and significant reductions in grain quality. The three most important weather factors affecting epidemics of stripe rust are moisture, temperature, and wind [3]. When weather conditions are relatively appropriate, the disease can spread rapidly over very long distances. Infection can occur anytime from the one-leaf stage to plant maturity provided plants are still green. The pathogen causing yellow rust infects the green tissues of plants of cereal crops and grasses. Such a disease utilizes water and nutrients from the host plants, which weakens the plants and the wheat yield and quality have been greatly reduced.

<https://ieeexplore.ieee.org/document/7577620>

@INPROCEEDINGS{7577620, author={J. {Zhao} and D. {Zhang} and L. {Huang} and Q. {Zhang} and W. {Liu} and H. {Yang}}, booktitle={2016 Fifth International Conference on Agro-Geoinformatics (Agro-Geoinformatics)}, title={Vertical features of yellow rust infestation on winter wheat using hyperspectral imaging measurements}, year={2016}, volume={}, number={}, pages={1-4}, doi={10.1109/Agro-Geoinformatics.2016.7577620}}`

**Yellow Rust in wheat - Identification and Management.**

The ideal growth conditions for yellow rust are temperatures of between 8-13oC for spore germination and penetration, and 12-15oC for further development and with free water. This makes yellow rust more of a spring disease. It should be noted, however, that whilst young plants can be susceptible, as they mature, they can develop “adult plant resistance”.

### How does yellow rust impact wheat yields?

The yield penalties from yellow rust in [**wheat**](https://cropscience.bayer.co.uk/your-crop/wheat/) can range from 5% to as high as 30% in high disease pressure scenarios (highly susceptible varieties in coastal regions/eastern counties). These penalties result from rust colonies in the leaf, draining carbohydrate from the plant and reducing green leaf area. Severe infections result in poor root growth and drought susceptibility

https://cropscience.bayer.co.uk/threats/diseases/wheat-diseases/yellow-rust-in-wheat/

# Yellow Rust Epidemics Worldwide Were Caused by Pathogen Races from Divergent Genetic Lineages.

Crop pathogens with worldwide prevalence and potential for long distance migration and invasions into new areas may pose a serious threat to food security regionally or globally ([Brown and Hovmøller, 2002](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full#B14); [Dean et al., 2012](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full#B17); [Beddow et al., 2015](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full" \l "B9)). Crops like wheat, which are cultivated worldwide across diverse agro-ecological zones, provide a vast niche for their pathogens at local, regional, and continental scales ([von Broembsen, 1989](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full#B74); [Brasier and Buck, 2001](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full#B12)). Wheat pathogens have been controlled to a large extent via ongoing and large-scale breeding efforts to improve disease resistance, which is economical, environment friendly and sometimes the only available option ([Singh et al., 2016](https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full#B66)).

<https://www.frontiersin.org/articles/10.3389/fpls.2017.01057/full>

@ARTICLE{10.3389/fpls.2017.01057,

AUTHOR={Ali, Sajid and Rodriguez-Algaba, Julian and Thach, Tine and Sørensen, Chris K. and Hansen, Jens G. and Lassen, Poul and Nazari, Kumarse and Hodson, David P. and Justesen, Annemarie F. and Hovmøller, Mogens S.},

TITLE={Yellow Rust Epidemics Worldwide Were Caused by Pathogen Races from Divergent Genetic Lineages},

JOURNAL={Frontiers in Plant Science},

VOLUME={8},

PAGES={1057},

YEAR={2017}, URL={https://www.frontiersin.org/article/10.3389/fpls.2017.01057},

DOI={10.3389/fpls.2017.01057}, ISSN={1664-462X}, }

Egyptian Academic Journal of Biological Sciences.

Yellow (stripe) rust of wheat (Triticum aestivum L.),caused by Puccinia striiformis f. sp. tritici, is a serious problem of wheat production in many parts of the world including Egypt. Virulence patterns of wheat stripe rust were studied under the field conditions in four growing seasons (2013 to 2017) at Sakha Agriculture Research Station by planting international stripe rust

trap nursery of differentials sets,

Yellow (stripe) rust caused by Puccinia striiformis Westend f. sp. tritici

Eriks, is the major foliar disease of wheat, resulting in yield loss all over the world

(Kolmer, 1966). Stripe rust severely damages wheat production worldwide (Roelf et

al., 1992; Line, 2002) **causing yield losses from 10 to 70%** besides affecting the

quality of grain and forage (Chen, 2005). In Egypt, four sudden disease epidemics

were recorded during the five elapsed decades (1967 - 1997). The first yellow rust

epidemic was recorded in 1967.

<https://drive.google.com/file/d/1X7BUyG0lTKyqEFT1kiRI8VrTf105GUkY/view>

(Good Diagrams !!!)

Wheat Stem rust and climatic changes in Egypt during the last five years. **(Very Important)**

Stem rust of wheat caused by the fungus Puccinia graminis Pers. f. sp. Tritici. Eriks and E. Henn, was the most destructive disease of wheat worldwide and Egypt, particularly on the late sowings. Successful control of the disease over three decades through the use of genetic resistance has resulted in a sharp decline in research activity in recent years. Performance of Egyptian wheat varieties and stem rust resistant genes were changed during the last five years. Most of our varieties were resistant to stem rust infection at adult stages in the field and it become susceptible, also stem rust resistant genes were in the parallel line. This changes correlated to climatic change specially the temperature and humidity. Temperature and humidity increase at the last year and height infection type were observed on these Cvs. and stem rust resistant genes. Most of these genes were temperature sensitive (Sr 6, 12, 13, 15, 17, 22, 34, 38). Cvs. Giza 168, Misri-1 and Misri-2 have the highest disease severities reflected to changing on temperature degrees.

longdom.org/proceedings/wheat-stem-rust-and-climatic-changes-in-egypt-during-the-last-five-years-16222.html

PARTIAL RESISTANCE OF WHEAT (TRITICUM AESTIVUM) TO

LEAF RUST (PUCCINIA TRITICINA) IN EGYPT.

A. EVALUATION OF SEVEN EGYPTIAN WHEAT CULTIVARS FOR

PARTIAL RESISTANCE AGAINST LEAF RUST, UNDER FIELD

CONDITIONS. **(Must Read)**

**Leaf rust is the most prevalent and widespread disease of**

**wheat in Egypt and worldwide. The major obstacle in the control of**

**such disease is the loss of host genetic resistance, as the pathogen**

**evolves into new pathotypes**.

**Leaf rust (Puccinia triticinia Eriks), is among the most common and**

**widespread foliar diseases of wheat in Egypt. It occurs annually in almost all the**

**cultivated wheat varieties, throughout many fields in the country. Moreover, it causes**

**a considerable yield losses (reaching 23%) in the susceptible wheat cultivars under**

**suitable environmental conditions, particularly in the northern parts of the Delta**

**region (Nazim et al., 1983). Utilization of resistant cultivars is still an economical,**

**environmentally safe and most effective method for successful disease control via**

**avoiding the sudden occurrence of damaging leaf rust epidemics. However, the major**

**obstacle in the control of wheat leaf rust is the short duration and rapid loss of the**

**host inherited resistance**

https://drive.google.com/file/d/1X8JHKF\_9peZYbiecGHDR0jp1k6wjMpP6/view