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Wheat yellow rust

Wheat yellow rust (***Puccinia striiformis* f.sp. *tritici***), also known as **wheat stripe rust**, is one of the three major wheat rust diseases, along with stem rust of wheat (*Puccinia graminis* f.sp. tritici) and leaf rust (*Puccinia triticina* f.sp. tritici).

History

As R.P. Singh, J. Huerta-Espino, and A.P. Roelfs say in their 2002 comprehensive review of literature on the wheat rusts for UN FAO:[1]

> Although Gadd first described stripe rust of wheat in 1777, it was not until 1896 that Eriksson and Henning (1896) showed that stripe rust resulted from a separate pathogen, which they named *P. glumarum*. In 1953, Hylander et al. (1953) revived the name *P. striiformis*.

A stripe rust outbreak in northwest Syria contributed to the beginning of the Syrian Civil War by increasing food prices.[2]

Life cycle

Other cereal rust fungi have macrocyclic, heteroecious life cycles, involving five spore stages and two phylogenetically unrelated hosts. *P. striiformis* was thought to be microcyclic for centuries until 2009, when a team of scientists at the USDA-ARS Cereal Disease Lab led by Yue Jin confirmed that barberry (*Berberis* and *Mahonia* spp.) is an alternate host.[3] Barberry was known as an alternate host of the closely related stem rust (*Puccinia graminis*) and for many years, when infection was observed on barberry, it was assumed to be stem rust.[4] (Then *P. striiformis* was accidentally discovered to *also* have the same alternate host when scientists observed rust infection on various barberry species, and inoculated spores of this unknown rust onto Poaceae hosts.[3] Kentucky Bluegrass

Wheat yellow rust

Yellow rust on the leaves of winter triticale

Scientific classification

Kingdom:	Fungi
Division:	Basidiomycota
Class:	Urediniomycetes
Subclass:	Incertae sedis
Order:	Uredinales
Family:	Pucciniastraceae
Genus:	*Puccinia*
Species:	*P. striiformis*
Form:	***P. s.* f. sp. *tritici***

Trinomial name

Puccinia striiformis* f. sp. *tritici

Westend., (1854)

was the only one to show infection. The uredinia were characteristic of stripe rust.)[3][5] Later, infected wheat plants bearing teliospores were soaked in water and suspended over barberry species. Infection was produced, thus solving a "century-old mystery" of plant pathology.[3] This finding is regarded as revolutionary across the discipline and additionally among mycologists.[6][5][7][8][9]

Synonyms

- *Dicaeoma glumarum*
- *Puccinia glumarum*
- *Puccinia rubigo-vera*
- *Puccinia straminis*
- *Puccinia striiformis*
- *Trichobasis glumarum*
- *Uredo glumarum*

Symptoms

Yellow rust, or stripe rust, takes its name from the appearance of yellow-colored stripes produced parallel along the venations of each leaf blade. These yellow stripes are actually characteristic of uredinia that produce yellow-colored urediniospores. Primary hosts of yellow rust of wheat are *Triticum aestivum* (bread wheat), *Triticum turgidum* (durum wheat), triticale, and a few *Hordeum vulgare* (barley) cultivars. Berberris serves as its alternative host.

Yellow rust distribution in winter triticale

The disease usually occurs early in the growth season, when temperature ranges between 2 and 15 °C (36 and 59 °F); but it may occur to a maximum of 23 °C (73 °F). High humidity and rainfall are favorable conditions for increasing the infection on both leaf blade and leaf sheath, even on spikes when in epidemic form. Symptoms are stunted and weakened plants, shriveled grains, fewer spikes, loss in number of grains per spike and grain weight. Losses can be 50%, but in severe situations 100% is vulnerable. Since yellow rust can occur whenever the wheat plants in green and the environmental condition conducive for the spore infection, yellow rust is a severe problem in the wheat-producing regions worldwide. Temperatures during the time of winter wheat emergence and the coldest period of the year are crucial for epidemic development in winter-habit wheat crops.[10]

Stripe rust on wheat

Worldwide population structure

Both the spatial genetic structure and the spatial dissemination of this disease have been investigated.[11] Population genetic analyses indicate a strong regional heterogeneity in levels of recombination, with clear signatures of recombination in the Himalayan and near-Himalayan regions and a predominant clonal population structure in other regions. The existence of a high genotypic diversity, recombinant population structure, high sexual reproduction ability, and the

abundance of the alternate host (*Berberis* spp.) in the Himalayan and neighboring regions suggest the region as a plausible *Pst* center of origin or at least very close to its centre of origin. However, further exploration may be useful from Central Asia to East Asian regions.[11]

Disease management

Breeding of resistant varieties is the most cost-effective method to control this rust. Fungicides are available but vary in availability depending on their registration restrictions by national or state governments.[12][13] Development of varieties resistant to the disease is always an important objective in wheat breeding programs for crop improvement. This has been done in the past, however as normal, these resistance genes became ineffective due to the acquisition of virulence to that particular resistance gene rendering the variety susceptible - necessitating ongoing variety development.[14]

Resistance genes

These genes are most often abbreviated *Yr* and *Yr1*, *Yr24*, etc.

QYr.niab-2D.1 is a quantitative trait locus (QTL) for adult plant resistance (APR).[15] This allele comes from the Claire variety.[15] Bouvet *et al.*, 2021 discovered it when investigating unknown resistance in the UK 2015 and 2016 seasons.[15] It has since broken down however.[15]

Lebanon

Although *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr10*, *Yr17*, *Yr24*, *Yr25*, and *Yr27* are no longer effective in Lebanon, *Yr1*, *Yr3*, *Yr4*, *Yr5*, *Yr15* are still effective against yellow rust pathotypes prevalent there.[16]

See also

- *Puccinia striiformis* var. *striiformis*

References

1. Singh, R.P.; Huerta-Espino, J.; Roelfs, A.P. "The wheat rusts" (http://www.fao.org/docrep/006/Y4011E/y4011e0g.htm). *www.fao.org*. Retrieved 2018-08-25.
2. Schwartzstein, Peter (2016-09-05). "Inside the Syrian Dust Bowl" (http://foreignpolicy.com/2016/09/05/inside-the-syrian-dust-bowl-icarda-assad-food-security-war/). *Foreign Policy*. The FP Group. Retrieved 2021-10-22.
3. Jin, Yue; Szabo, Les J.; Carson, Martin (2010-04-07). "Century-Old Mystery of *Puccinia striiformis* Life History Solved with the Identification of *Berberis* as an Alternate Host" (https://doi.org/10.1094%2FPHYTO-100-5-0432). *Phytopathology*. **100** (5): 432–435. doi:10.1094/PHYTO-100-5-0432 (https://doi.org/10.1094%2FPHYTO-100-5-0432). ISSN 0031-949X (https://search.worldcat.org/issn/0031-949X). PMID 20373963 (https://pubmed.ncbi.nlm.nih.gov/20373963).
4. Stakman, Elvin C. (1918). *The black stem rust and the barberry* (https://www.biodiversitylibrary.org/bibliography/135472). Washington, D.C.: Government Printing Office. doi:10.5962/bhl.title.135472 (https://doi.org/10.5962%2Fbhl.title.135472).

5. Wellings, Colin R. (2011-02-04). "Global status of stripe rust: a review of historical and current threats". *Euphytica*. **179** (1). Springer: 129–141. doi:10.1007/s10681-011-0360-y (https://doi.org/10.1007%2Fs10681-011-0360-y). ISSN 0014-2336 (https://search.worldcat.org/issn/0014-2336). S2CID 12772004 (https://api.semanticscholar.org/CorpusID:12772004).
6. Dean, Ralph; Van Kan, Jan A. L.; Pretorius, Zacharias A.; Hammond-Kosack, Kim E.; Di Pietro, Antonio; Spanu, Pietro D.; Rudd, Jason J.; Dickman, Marty; Kahmann, Regine; Ellis, Jeff; Foster, Gary D. (2012-04-04). "The Top 10 fungal pathogens in molecular plant pathology" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6638784). *Molecular Plant Pathology*. **13** (4). British Society for Plant Pathology (Wiley): 414–430. doi:10.1111/j.1364-3703.2011.00783.x (https://doi.org/10.1111%2Fj.1364-3703.2011.00783.x). ISSN 1464-6722 (https://search.worldcat.org/issn/1464-6722). PMC 6638784 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6638784). PMID 22471698 (https://pubmed.ncbi.nlm.nih.gov/22471698). S2CID 18505064 (https://api.semanticscholar.org/CorpusID:18505064).
7. Chen, Wanquan; Wellings, Colin; Chen, Xianming; Kang, Zhengsheng; Liu, Taiguo (2014-05-06). "Wheat stripe (yellow) rust caused by *Puccinia striiformis* f. sp. *tritici*" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6638732). *Molecular Plant Pathology*. **15** (5). British Society for Plant Pathology (Wiley): 433–446. doi:10.1111/mpp.12116 (https://doi.org/10.1111%2Fmpp.12116). ISSN 1464-6722 (https://search.worldcat.org/issn/1464-6722). PMC 6638732 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6638732). PMID 24373199 (https://pubmed.ncbi.nlm.nih.gov/24373199). S2CID 37796070 (https://api.semanticscholar.org/CorpusID:37796070).
8. Möller, Mareike; Stukenbrock, Eva H. (2017-08-07). "Evolution and genome architecture in fungal plant pathogens". *Nature Reviews Microbiology*. **15** (12). Nature Portfolio: 756–771. doi:10.1038/nrmicro.2017.76 (https://doi.org/10.1038%2Fnrmicro.2017.76). ISSN 1740-1526 (https://search.worldcat.org/issn/1740-1526). PMID 28781365 (https://pubmed.ncbi.nlm.nih.gov/28781365). S2CID 23589377 (https://api.semanticscholar.org/CorpusID:23589377).
9. Hovmøller, Mogens S.; Sørensen, Chris K.; Walter, Stephanie; Justesen, Annemarie F. (2011-09-08). "Diversity of *Puccinia striiformis* on Cereals and Grasses". *Annual Review of Phytopathology*. **49** (1). Annual Reviews: 197–217. doi:10.1146/annurev-phyto-072910-095230 (https://doi.org/10.1146%2Fannurev-phyto-072910-095230). ISSN 0066-4286 (https://search.worldcat.org/issn/0066-4286). PMID 21599494 (https://pubmed.ncbi.nlm.nih.gov/21599494). S2CID 41199857 (https://api.semanticscholar.org/CorpusID:41199857).
10. Aslanov, Rufat; Moussa El Jarroudi; Mélanie Gollier; Marine Pallez-Barthel; Marco Beyer (2019-01-04). "Yellow rust does not like cold winters. But how to find out which temperature and time frames could be decisive in vivo?" (https://orbi.uliege.be/handle/2268/230814). *Journal of Plant Pathology*. online first (1): 539–546. doi:10.1007/s42161-018-00233-y (https://doi.org/10.1007%2Fs42161-018-00233-y). hdl:2268/230814 (https://hdl.handle.net/2268%2F230814). S2CID 91716438 (https://api.semanticscholar.org/CorpusID:91716438).
11. Ali, Sajid; Pierre Gladieux; Marc Leconte; Angélique Gautier; Annemarie F. Justesen; Mogens S. Hovmøller; Jérôme Enjalbert; Claude de Vallavieille-Pope (2014-01-23). "Origin, Migration Routes and Worldwide Population Genetic Structure of the Wheat Yellow Rust Pathogen *Puccinia striiformis* f.sp. *tritici*" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3900651). *PLOS Pathogens*. **10** (1) e1003903. doi:10.1371/journal.ppat.1003903 (https://doi.org/10.1371%2Fjournal.ppat.1003903). PMC 3900651 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3900651). PMID 24465211 (https://pubmed.ncbi.nlm.nih.gov/24465211).
12. Washington State University College of Agricultural, Human, and Natural Resource Sciences. "Stripe Rust" (https://www.striperust.wsu.edu). Washington State University. Retrieved 2 August 2018.
13. "Wheat Stripe Rust" (https://extension.usu.edu/files/publications/factsheet/wheat-stripe-rust08.pdf) (PDF). Utah Pests fact sheet. Utah State University Extension and Utah Plant Pest Diagnostic Laboratory. 2008. PLP-002-PR.

14. This book...

• Kang, Zhensheng; Chen, Xianming (2017). Chen, Xianming; Kang, Zhensheng (eds.). *Stripe Rust*. Dordrecht: Springer Netherlands. pp. vii+719. doi:10.1007/978-94-024-1111-9 (https://doi.org/10.1007%2F978-94-024-1111-9). ISBN 978-94-024-1109-6. LCCN 2017943111 (https://lccn.loc.gov/2017943111). OCLC 1006649931 (https://search.worldcat.org/oclc/1006649931). S2CID 30527470 (https://api.semanticscholar.org/CorpusID:30527470). 978-94-024-1111-9. 978-94-024-1491-2. 978-94-024-1109-6.
:37,98–99,105,294

...cites this study:

• de Vallavieille-Pope, Claude; Ali, Sajid; Leconte, Marc; Enjalbert, Jérôme; Delos, Marc; Rouzet, Jacques (1 January 2012). "Virulence Dynamics and Regional Structuring of *Puccinia striiformis* f. sp. *tritici* in France Between 1984 and 2009" (https://doi.org/10.1094%2Fpdis-02-11-0078). Special Report. *Plant Disease*. **96** (1). American Phytopathological Association (APS): 131–140. doi:10.1094/pdis-02-11-0078 (https://doi.org/10.1094%2Fpdis-02-11-0078). PMID 30731861 (https://pubmed.ncbi.nlm.nih.gov/30731861). S2CID 73450078 (https://api.semanticscholar.org/CorpusID:73450078).

15. Bouvet, Laura; Holdgate, Sarah; James, Lucy; Thomas, Jane; Mackay, Ian; Cockram, James (2021). "The evolving battle between yellow rust and wheat: implications for global food security" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8942934). *Theoretical and Applied Genetics*. **135** (3). Springer Science and Business Media LLC: 741–753. doi:10.1007/s00122-021-03983-z (https://doi.org/10.1007%2Fs00122-021-03983-z). ISSN 0040-5752 (https://search.worldcat.org/issn/0040-5752). PMC 8942934 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8942934). PMID 34821981 (https://pubmed.ncbi.nlm.nih.gov/34821981). S2CID 236275608 (https://api.semanticscholar.org/CorpusID:236275608). JC ORCID 0000-0002-1014-6463 (https://orcid.org/0000-0002-1014-6463).
16. El Amil, Rola (2020-11-09). *(DAY 2) - Phytosanitary Safety for Transboundary pest prevention - Yellow and Black rust population variability* (https://youtube.com/watch?v=9ksaCvAy_XQ&t=2677). CGIAR Germplasm Health Webinar series. Vol. Phytosanitary Awareness Week. International Institute of Tropical Agriculture / CGIAR. Slide at 00:44:37. Lebanese Agricultural Research Institute, Lebanon. Archived (https://ghostarchive.org/varchive/youtube/20211221/9ksaCvAy_XQ) from the original on 2021-12-21.

- Ali S. (2012) Population biology and invasion history of Puccinia striiformis f.sp. tritici at worldwide and local scale, Ph.D. dissertation. Université Paris-Sud 11.
- Chen, X. M. 2005. Epidemiology and control of stripe rust [Puccinia striiformis f. sp. tritici] on wheat. Can. J. Plant Pathol. 27:314-337.
- Doodson, J.K., Manners, J.G. and Myers, A. (1964). Some effects of yellow rust (*Puccinia striiformis*) on the growth and yield of spring wheat. Ann. Bot. 28: 459–472.
- Eriksson, J. and E. Henning. 1896. Die Getreideroste. Ihre Geschichte und Natur sowie Massregein gegen dieselben. P. A. Norstedt and Soner, Stockholm. 463 pp.
- Hogg, W.H., Hounam, C.E., Malik, A.K., and Zadoks, J.C. 1969. Meteorological factors affecting the epidemiology of wheat rusts. WMO Tech Note 99. 143 pp.
- Hovmøller, M. S., Sørensen, C. K., Walter, S., Justesen, A. F. (2011) Diversity of Puccinia striiformis on cereals and grasses. Annual Review of Phytopathology 49, 197–217.
- Hylander, N., I. Jorstad and J.A. Nannfeldt. 1953. Enumeratio uredionearum Scandinavicarum. Opera Bot. 1:1-102.
- Jin, Y., Szabo, L.J., and Carson, M. 2010. Century-old mystery of Puccinia striiformis life history solved with the identification of Berberis as an alternate host. Phytopathology 100:432-435.
- Poehlman J.M. and D.A. Sleper. 1995. Breeding Field Crops. 4th Ed. Iowa State Press/Ames, Iowa 50014.
- Robbelen, G. and Sharp, E. L., 1978. Mode of inheritance, interaction and application of genes conditioning resistance to yellow rust. Adv. Plant Breeding, 9, 88 pp.

- Saari, E. E. and Prescott, J. M., 1985. World distribution in relation to economic losses. Pages 259–298, in: The Cereal Rusts Vol. II: Diseases, distribution, epidemiology and control, A. P. Roelfs and W. R. Bushnell eds., Academic Press, Orlando, Fl.
- Stubbs, R. W., 1985. Stripe rust. Pages 61–101 in: The Cereal Rusts Vol. II: Diseases, distribution, epidemiology and control, A. P. Roelfs and W. R. Bushnell eds., Academic Press, Orlando, Fl. Zadoks, J. C. and Bouwman, J. J., 1985. Epidemiology in Europe. Pages 329–369 in: The Cereal Rusts Volume II: Diseases, distribution, epidemiology and control, A. P. Roelfs and W. R. Bushnell eds., Academic Press, Orlando, Fl.

External links

- usda.gov (https://www.ars.usda.gov/ARSUserFiles/50620500/Publications/CerealRusts/The%20Cereal%20Rusts_VOLUME%20II.pdf)
- usda.gov (https://www.ars.usda.gov/ARSUserFiles/50620500/Cerealrusts/stripe_rust_control.pdf)
- usda.gov (https://www.ars.usda.gov/ARSUserFiles/50620500/Cerealrusts/Pst-life-cycle%20Phyto-reprint.pdf)
- http://www.cimmyt.org
- usda.gov (https://www.ars.usda.gov/midwest-area/stpaul/cereal-disease-lab/)
- "Yellow Rust" (http://www.wheat-rust-genomics.com/stripe-rust/). Retrieved 2021-05-26.