Soybean Rust
Phakopsora pachyrhizi

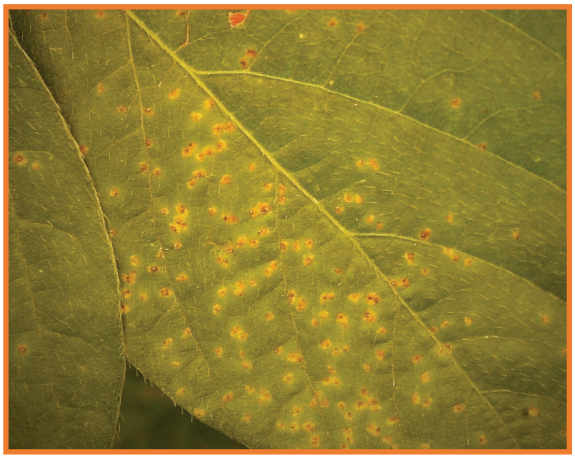
Soybean rust is a foliar disease caused by an obligate biotrophic fungus, *Phakopsora pachyrhizi*, and has been established in Sub-Saharan Africa (SSA) since it was first identified in Zambia in 1978[1,2]. The pathogen can infect many legume species. **The most economically impacted host is soybean. As a foliar disease, soybean rust results in reduced photosynthesis and defoliation with up to 80% yield reductions in worst-case scenarios.**

Symptoms: Soybean rust symptoms are commonly found on the underside of the leaf and first appear as small, water-soaked lesions that gradually turn into lesions 2-5mm in diameter. Within the lesions, spore-containing structures (uredinia) are visible with the aid of a dissecting microscope or hand lens. These will produce copious amounts of airborne spores that will go on to infect other soybean plants. Leaves will start to yellow, or become chlorotic, as the disease progresses. Severe infections cause premature defoliation and early maturation.

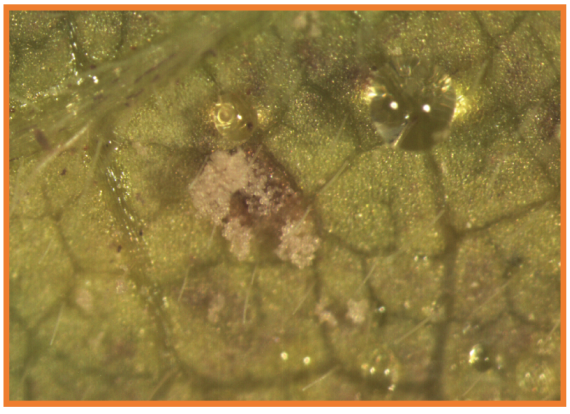
Disease Cycle: Spores of *P. pachyrhizi* are easily disseminated by and readily mix with air currents for short and long distance dispersal. Spores that land on leaves need some leaf wetness like overnight dew to germinate to establish a new infection point. Disease symptoms can appear as early as seven days after infection and lesions can continue to exhibit new uredinia resulting in more spore production.

Scouting for Soybean Rust: Rust lesions may appear even before flowering but are more commonly observed between flowering through to the end of the season. Lesions often are observed first lower in the plant canopy and move upwards as the disease progresses. Scouting for rust may be done multiple times during the season. The severity of rust is usually greatest at growth stage R6 to R7 just before the plant reaches maturity and this is the best time to take notes for evaluating for resistance. Scouting is done by surveying a field or plot in a W-shape or zig zag pattern and randomly selecting plants to examine for symptoms.

Leaf chlorosis (yellowing) and necrosis (dead tissue) caused by rust



Lesions on the upper-side of a leaf caused by soybean rust



Spores of *Phakopsora pachyrhizi* spores oozing out of a lesion on the underside of a soybean leaf

Disease bulletins provide information about disease and pest identification, development, and management for economically important diseases and pests impacting soybean production in Sub-Saharan Africa. Bulletins are written by Drs. Michelle Pawlowski, Harun Murithi, and Glen Hartman. For more information on soybean disease management, please email us at soybeaninnovationlab@illinois.edu

Impact on Yields: As a foliar disease, soybean rust causes a reduction in photosynthesis and an increase in premature defoliation. This leads to fewer pods and smaller seeds, resulting in lower yields. In general, with every 10% increase in rust severity there may be a 10% reduction in yield. Yield losses range from 10-80%. For example, losses in SSA have been reported to be between 27-80% with losses in Zimbabwe averaging 60-80%[3].

Severe soybean rust outbreak in a soybean field in Malawi

Disease Management: An effective method to control soybean rust is with fungicides. Triazoles are recommended for single fungicide applications as they prevent new infections. Triazole+strobulurin mixtures will provide longer residual protection than either fungicide alone. Fungicide applications should only be considered during late vegetative to R6 growth stages and may not be needed if conditions turn dry and rain and dew are not common. Spraying is not economically feasible if the disease has progressed to the upper canopy or if plants are past the R6 growth stage. Fungal insensitivity, or pathogen resistance to pesticidal spraying, has been reported for both strobilurins and triazoles. Appropriate application is necessary to reduce the risk of developing fungal insensitivity[4]. Fungicide availability will vary by location so please check with your extension agent for an updated list of available products.

Treatment Type	Disease progression	Fungicide Application	Action
Preventative	<2% disease observed in lower canopy	triazole or triazole+strobilurin mixture	Monitor carefully. If disease progresses and conditions are conducive, consider a second application
Early Curative	<10% disease observed in lower canopy No disease in mid-canopy	triazole or triazole+strobilurin mixture	Monitor carefully. If disease progresses and conditions are conducive, consider a second application 7-14 days later
Late Curative yield loss may already have occurred	<20% disease in lower canopy <10% disease in mid-canopy	triazole or triazole+strobilurin mixture	Make a second application 14 days later
Too Late	>10% disease in mid-canopy Any disease presence in upper canopy	Spraying will not produce economic return	

General fungicide recommendations for soybean rust. Please consult your local extension agent and follow fungicide instructions for concentrations and use.

Using resistant varieties is the more economical and sustainable means of managing soybean rust. Currently only a few commercial rust-resistant soybean varieties are available that are adapted for Sub-Saharan Africa. However, the Pan African Soybean Variety Trials (PAT) have shown differences in disease response among soybean varieties. The 2019-2020 PAT Trials in Malawi identified twelve varieties with an average rating less than 2, or with less than 10% leaf rust severity. The top three varieties were **SC Saga**, **SC Signal**, and **S1180/5/54**.

General management methods alone will not have effective control but may aid in alleviating rust severity in conjunction with other management options. Cultural management methods include: planting early and using early maturity groups to avoid infection during the susceptible period (flowering), sanitizing equipment and fields that have had historically bad outbreaks, and rotating with a non-host, such as corn.

References: [1]Goellner, et al 2010. Plant Pathology 11:169-177. [2]Murithi, et al 2016. Plant Pathology 65:176-188. [3]Tukamuhabwa and Maphosa 2010. FAO Report. [4]Langenbach et al 2016. Frontiers in Plant Science 7:797.

Seed sources: SC Saga, SC Signal, and S1180/5/54 are varieties sourced from Seed Co for more information on obtaining rust tolerant seed sources please visit www.seedcogroup.com.