Host and Host-Rust Interactions

by M.R. Bonde, USDA-ARS and
Herb Edwards, Western Illinois University
“.. an analysis of the threat of rust to soybeans in the United States must await the results of other studies involving the potential host range and pathogen survival.”

J.S. Melching, K.R. Bromfield, C.H. Kingsolver 1979
Objective:  Determine susceptibility of various legumes to soybean rust under greenhouse conditions

A. winter legumes
B. legume crops other than soybean
Procedure

• Inoculate plants at about one month of age.
• Examine 2 weeks after inoculation.
• Record reaction type.
• Rate lesion density and percent of lesions sporulating.
• Collect leaf tissue, fix, clear and stain.
• Determine average number of uredinia per lesion and average uredinia diameter.
• Calculate spore producing area per lesion (SPAPL).
Soybean Reaction Types

Tan

RB

Mixed
Kudzu Reaction Types

Tan  RB  Mixed
Soybean rust reactions 14 days after inoculation of U.S. accessions of Kudzu with *P. pachyrhizi*
Spore producing area per lesion –
Calculate from average number of uredinia per lesion and average uredinia diameter on stained leaves.

79,300 µm²  3,500 µm²  12,700 µm²
Clover
- Dixie crimson
- Royal ladino
- Yuchi arrowleaf

Cowpea
- Charleston greenpack
- Coronet
- Mississippi silver
- Top pinkeye
- White acre
- Caprice
- Contender
- Labrador
- Masai
- Minuet
- Roma II
- Tapia
- Austrian winter
- Bolero
- Early freezer 680
- Genie
- 184-85
- C-elite
- Cypress
- Fordhook conc.
- Henderson
- Jackson wonder
- White Dixie

Lima
- Williams

Pea
- Beggarweed
- Coffee sesbania
- Hemp sesbania
- Kudzu, tropical
- Kudzu, resistant
- Kudzu, susceptible
- Partidge pea
- Showy crotaleria
- Hyacinth bean

Green Bean
- Caprice
- Contender
- Labrador
- Masai
- Minuet
- Roma II
- Tapia
- Austrian winter
- Bolero
- Early freezer 680
- Genie
- 184-85
- C-elite
- Cypress
- Fordhook conc.
- Henderson
- Jackson wonder
- White Dixie

Weeds
- Beggarweed
- Coffee sesbania
- Hemp sesbania
- Kudzu, tropical
- Kudzu, resistant
- Kudzu, susceptible
- Partidge pea
- Showy crotaleria
- Hyacinth bean

SPAPL, x 10^3 m^2

0 20 40 60 80 100
Conclusions

- Clovers – not very important
- Cow pea – susceptible but does not sporulate well
- Green beans – some fairly susceptible
- Green peas - very susceptible but leaves fall rapidly
- Lima beans – susceptible but does not sporulate
- Kudzu – susceptible with high sporulation in general
Appressorium penetrating directly through host leaf surface.

Urediospore of soybean rust fungus.

Scanning electron microscope image
Soybean rust appressorium
Soybean leaf cuticle
Cell wall

Transmission electron microscope image

1.0 um
Appressorium

Leaf cell wall

Area of leaf cell wall that will be penetrated by the fungus.
Early stages in the development of the penetration hypha

Close up of early stage
Breaching stage of leaf cuticle and cell wall by penetration hypha.
Appressorium

Leaf cell wall

Penetration hypha

Close up of penetrated area of leaf. Note cuticle is curved inward but wall shows no signs of stress.
Appressorium
Cuticle
Cell wall

0.5 um
Penetration of lower leaf cell wall by penetration hypha into leaf photosynthetic cell.

Penetration of lower leaf cell wall by penetration hypha into leaf intercellular space.

Photosynthetic cell
Penetration hypha gives rise to primary infection hypha that grows throughout the interior of the leaf.