REVIEW: EFFECT OF SUGARCANE WHIP SMUT ON CANE YIELD AND SUGAR RECOVERY

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INTRODUCTION

SUGARCANE: : *Saccharum officinarum*

Total Area	:	1.20 million hectares
Sugarcane Production	:	81 million tons
Average Yield	:	69.55 tons/ha (Anonymous, 2021)

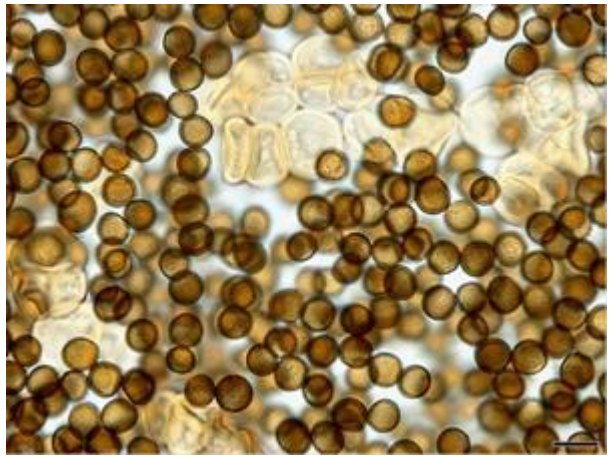
PATHOGEN:

Common Name	:	Whip Smut of Sugarcane
Causal Organism	:	*Ustilago scitaminea* Syd.

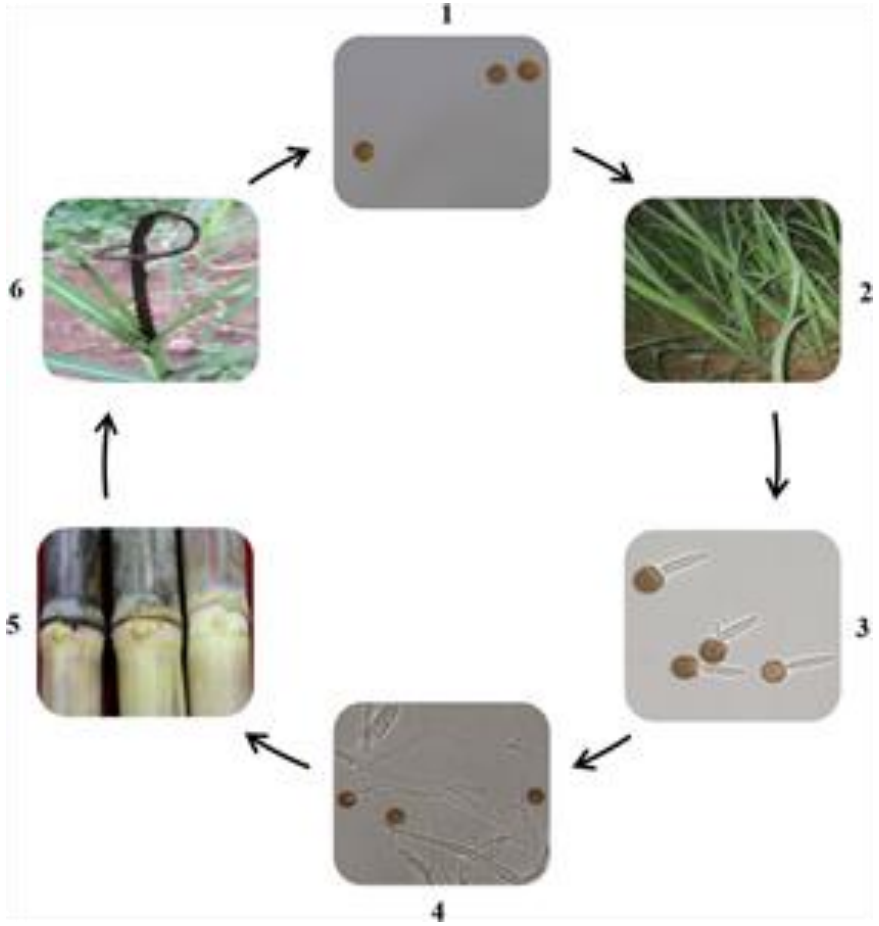
WHIP SMUT OF SUGARCANE




WHIP SMUT OF SUGARCANE



Teliospores of Whip Smut



Infection of Sugarcane Whip Smut:

1. Teliospores
2. Soil and/or sugarcane plants contamination
3. Teliospore germination
4. Germinating spores and fungal growth 5.
5. Infection of sugarcane meristem (growing point)
6. The formation of diseased panicle, with whip-like growth.

DISTRIBUTION

- Smut disease of sugarcane can cause considerable yield losses and reduction in cane quality (Ferreira & Comstock , 1989).
- It also resulted in significantly yield losses in sugarcane production and was reported to be distributed all over the sugarcane growing areas in China (Huang et. al., 2004).
- The disease was first reported in Australia in the Ord River Irrigation Area (ORIA) in 1998.
- More than 70% of Australia's sugarcane varieties were susceptible to smut before 1998. Since then, smut resistance became an objective of varietal selection in Australia (Croft & Berding, 2005).
- Firstly, the smut disease was reported in Pakistan on HSF-240 which was the major variety of the central Punjab.

EPIDEMIOLOGY

Symptoms:

Severely infected plants may be stunted with small, narrow leaves and abundant tillers; they look weak and grass-like. More than one flush of whips can cause considerable damage to crops of susceptible varieties. Eventually, the leaf spindle – young leaves & growing point – enclosed within the sheaths of older leaves is replaced with a long black whip, which emerges from the top of the plant.

Mode of Spread:

Primary spread : Infected seed setts

Secondary spread : Air-born, rain, irrigation and infected crop residues

DISEASE IMPACT ON CANE YIELD & SUGAR RECOVERY

- Production losses of 30 to 100% are reported depending on the susceptibility of the variety, the stain of the fungus, the environment and the age of the crop when infected.
- There is also a loss of quality as stems may have lower sugar contents. Breeding programs may be impacted because of the susceptibility of valuable lines.
- An approximate estimated of the yield loss (in Australia) is 6% for every 10% increase in the number of infected plants.
- In the case of susceptible varieties, large numbers of dead plants can result in the loss of the ratoon crop and additional cost due to replanting.
- On the other hand, in highly susceptible cultivars maximum reduction of 16.34% in brix, 25% in pol, 10.42% in purity, and 32% in CSS.

EVALUATION OF SUGARCANE CLONE TO SMUT

(Sarmad Mansoor *et. al.*, 2016)

Varieties / Clones	Disease Incidence (%)	Response
S-2003 US-618	46.43	S
S-2008 M-34	25.02	MS
S-2006 US-469	0	R
S-2006 US-272	0	R
S-2005 US-54	0	R
S-2008 AUS-133	18.45	MS
S-2008 AUS-130	0	R
S2003 US-127 (CPF-250)	21.80	MS
S-2006 US-658 (CPF-252)	0	R
S-2008 AUS-190	0	R
S-2003 US-704 (CPF-249)	16.58	MS
S-2008 Fd-19	24.42	MS
S-2008 AUS-107	0	R
S-2008 AUS-87	19.34	MS
S-2009 SA-169	0	R

EFFECT OF SMUT ON SUGARCANE PLANT

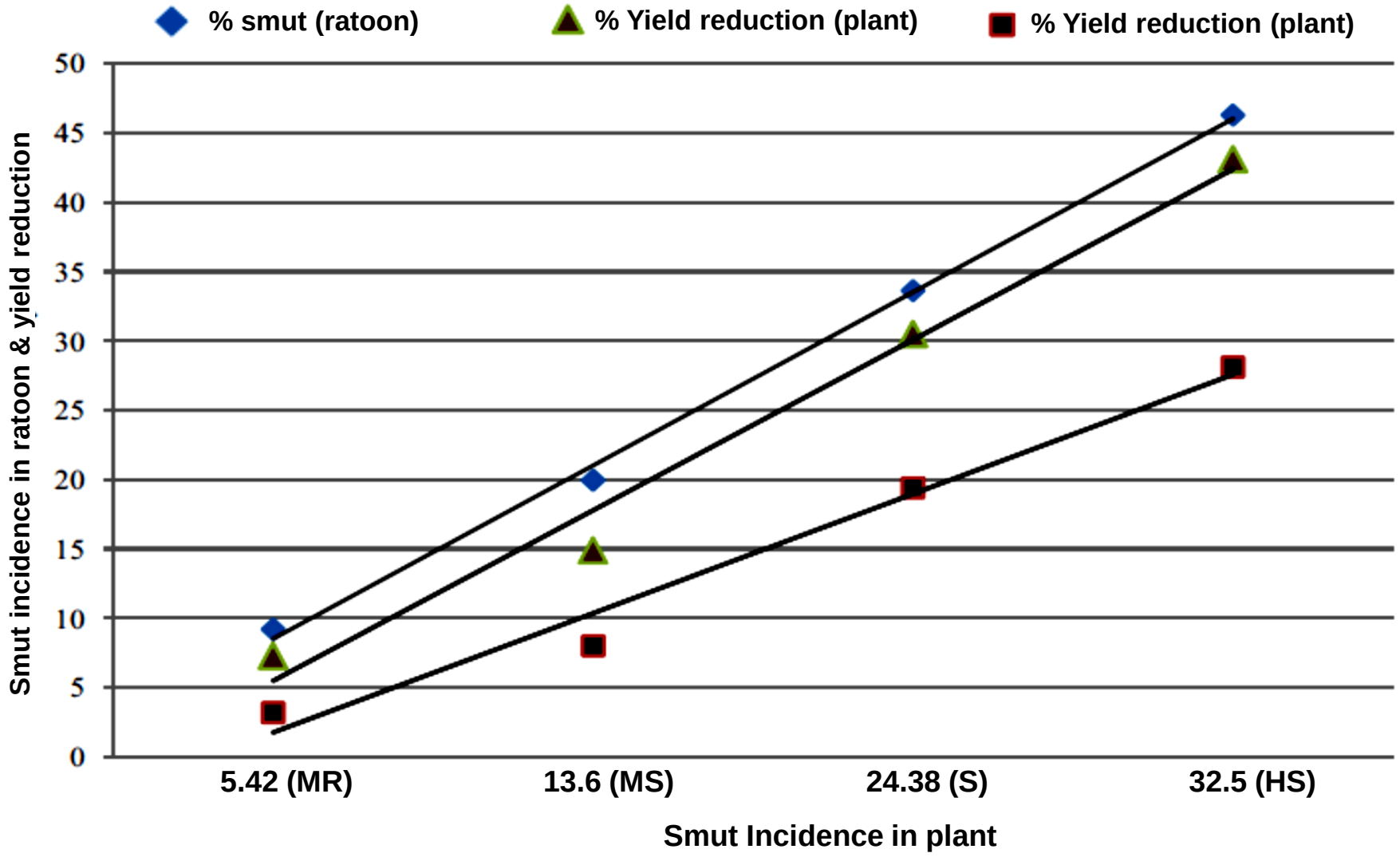
PHYSIOLOGY OF HEALTHY CANE

- Rich in Sugar Contents
- Normal Photosynthetic rate
- Normal Phytochemical profile

PHYSIOLOGY OF DISEASED CANE

- Reduced Sugar Contents
- Reduced Photosynthetic rate
- Altered Phytochemical profile

SMUT INCIDENCE ON YIELD OF PLANT & RATOON CROP



(Pawan *et. al.*, 2019)

DISEASE DIAGNOSIS

- Correct diagnosis of pathogens is the primary requirement in any disease management practices.
- Look for stunted plants and the characteristics black whips that emerge from the top of the stem.
- ELISA and PCR-based methods are available for detection of the fungus in buds of the sugarcane and reliable staining method using trypan blue has also given reliable results.
- NIR prediction of smut resistance.

DISEASE MANAGEMENT

- Rouging of infected clumps would assure a healthy crop.
- Periodical observations of the standing crop and removing the whips considerably reduce the disease severity.
- Use of Spectrum (Azoxystrobin + Tebuconazole) as sett treatment and the foliar application of Tebuconazole at the time of ratoon initiation and one month of ratooning can effectively minimize the disease intensity.
- ELISA and PCR-based methods are available for detection of the fungus in buds of the sugarcane and reliable staining method using trypan blue has also given reliable results.
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CONCLUSION

- As whip smut has the potential to cause substantial losses in susceptible cultivars.
- Regular monitoring, roughing and destruction of smut whip will help to reduce the inoculum.
- The ongoing and upcoming varietal development as well as cultivar screening programs should consider the presence of multiple races of smut pathogen in this region.
- There is a high need to study the rate and mechanism of the physiological specialization in smut pathogen as well as to confirm the presence of multiple races of *U. scitamineum* by recent molecular tools including race specific arrays.
- Breeding and varietal screening programs should adopt molecular-based detection techniques for early detection of smut infection in germplasm.
- Taken together, this review presents the current knowledge on various aspects of sugarcane smut and the disease management strategies, and future research directions are also proposed.

FUTURE PROSPECTS

- There is a need to directly focus on pathotyping and disease forecasting models.
- It is generally recognized that various biocontrol agents do not have the potential to thrive in newly introduced habitats, which is why it is also vital to introduce new antagonistic microbes.
- Increasing the frequency of smut resistance genes in parent and selection population, gradually reducing the current need to double the size of the variety improvement program.
- Implementation of new, innovative and efficient selection methods in sugarcane breeding populations segregating for smut resistance, including the use of:
    a. Marker assisted selection
    b. NIR prediction of smut resistance
    c. Seedlings screening methods
    d. Continuously monitor and improve research progress towards developing smut resistant varieties.

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Thank You