

Study on the Effects of Selected Plant Extracts on Sugarcane Smut Pathogen (*Ustilago scitaminea*)

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Introduction

Commercially grown sugarcane (*Saccharum Hybrid* spp.) are perennial grasses belongs to the family Poaceae. It is a C₄ plant which utilizes sun light very efficiently and grows well in tropical and frost-free warm temperate areas (Jalaja, 2001). Sugarcane Smut (*Ustilago scitaminea*) is one of the most devastating diseases in Sri Lankan sugarcane plantations among major sugarcane diseases. (Annual report SRI, 1997). The Sugarcane Smut disease is caused significant yield losses to sugarcane plantation (Agnihothi, 1990). Although, Smut resistant varieties are grown in the plantations, this particular disease could not be eliminated completely because there is a probability to appear this disease in some extent even in resistant varieties due to the nature of field resistance (Comstock, 1989). This situation can be further anticipated where resistant varieties are introduced into the areas with high inoculum density. Botanical control methods like antifungal plant spp. acclaimed as effective, eco-friendly and cheap, nullifying the ill effects of chemicals. Plant extracts like, *Calendula officinalis*, *Solanum nigrum* etc., have been found antagonistic to *Ustilago scitaminea* (Ji Lal.et al.2009). However, the information on use of botanicals for the management of the disease under field condition is entirely lacking (Ji Lal.et al. 2009). Therefore, considering the cost of chemical pesticides and the probable hazards involved in the use of chemical fungicides, biological control of plant diseases appears to be an effective and eco-friendly approach to increase crop yield. Therefore, the present study was to identify the possible plant species and their optimal concentration with fungicide to control Smut disease (*Ustilago scitaminea*).

Methodology

The twenty five plants species viz., *Azadirachta indica*, *Psidium guajava*, *Lantana camara* L., *Gliricidia maculate*, *Cinnamomun* sp., *Raphanus sativus*, *Tagetes erecta* L., *Solanum nigrum*, *Ricinus communis*, *Cyprus herbacea*, *Piper betle*, *Kaempferia* spp., *Alostonia scholaris*, *Zinger officinale* Roscoe, *glorisa superba*, *Cassia alata*, *Plectranthus zeylanicus*, *Carrica papaya*, *Citrus limon*, *Ocimum Sanctum*, *Filicium decipiens*, *Curucuma domestica*, *Elettaria cardamomum*, *Euphorbia heterophylla* *Syzygium aromaticum*, were used to obtain plant extracts for evaluation against Smut pathogen (*Ustilago scitaminea*) under in-vitro conditions.

Leaf extracts of the above plant species were prepared by crushing surface sterilized leaves with sterilized distilled water (1:1 w/v) using cleaned sterilized, motor and pestle. The extract of each plant was filtered through a sterilized double layered muslin cloth. Then the filtrate was centrifuged at 2000 rpm for 10 -15 minutes at 20 °C to get the supernatant. The smut whips which were collected from the Uda Walawe Research Farm were rubbed and fungal spores were collected. The spores were inoculated on PDA plates and were incubated at 28 ± 1 °C for four (04) days and continued sub cultures until getting pure cultures. Plant Extracts were tested *in-vitro* against Smut pathogen (*Ustilago scitaminea*) using dual culture method (Morton and Stroube.1955) with control. The plates were incubated at 28 ± 1 °C temperature for 48 hours. The growth of the pathogen was measured up to 15 days and was expressed as Percentage of Mycelia growth Inhibition (MGI) of smut.

where,

$$\text{MGI \%} = \frac{I_c - I_t}{I_c} \times 100$$

MGI %: Mycelia Growth Inhibition Percentage

I_t - Fungal colony length in treatment sets

I_c - Fungal colony length in control sets

The stock solutions of five positive plants extract were diluted with standard fungicide (Tebucinazole 250 g l⁻¹, Folicur EW® 250) to prepare nine different concentrations (10 % to 90 % with 10% increment) with the 100 % fungicide concentration as control. Solution with fungicide and leaf extracts was introduced to *Ustilago scitaminea* by dual culture method in PDA plates. Control plates were maintained by growing the pathogen in PDA plates with 100 % concentration of fungicide. The all plates were incubated at 28 ± 1 °C temperature for 48 hours. The percentage of growth inhibition of the mycelial colonies in different concentrations was calculated according to Mishra *et al* (2011) equation.

Result and Discussion

Leaf extracts of five (05) plant species found effective out of the twenty five (25) plant species to control the growth of smut pathogen.

Cinnamomum spp. (Family: Lauraceae) was recorded significantly (p value 0.043) in the highest antifungal activity 77.580 % (Table 1). *Elettaria cardamomum* (0.000 %), *Curucuma domestica* (2.028 %), *Azadirachta indica* (4.0002 %) showed weak inhibition ability against *Ustilago scitaminea* which causes smut disease in sugarcane (*Saccharum* spp.). Antifungal activity of the most plant species were reduced after 10 days of the inoculation and then the antifungal ability stopped although smut pathogen was still growing.

Table 1. Growth inhibition of *Ustilago scitaminea* against leaf extracts of plant species.

Growth inhibition of <i>Ustilago scitaminea</i>	
Plant extracts	% inhibition
<i>Lantana camara</i> L.	51.515%
<i>Tagetes erecta</i> L	43.249 %
<i>Cinnamomum</i> spp	77.580 %
<i>Kaempferia</i> spp	69.048 %
<i>Zinger officinale</i> Roscoe	69.725 %
Control	00.000 %

Each values is after fifteen days of inoculation

Table 2. Conducted measurements together with macro observation summarized with statistical analysis.

Friedman's test results: Average ranks:			
Plant extracts	p value	Treatment	Control
<i>Lantana camara</i> L.	0.043	6.00	3.00
<i>Tagetes erecta</i> L	0.043	6.00	3.00
<i>Cinnamomum</i> spp	0.043	6.00	3.00
<i>Kaempferia</i> spp	0.043	6.00	3.00
<i>Zinger officinale</i> Roscoe	0.043	6.00	3.00

The fungicide: Tebucinazole 250 g l⁻¹ (Folicur EW® 250) with plant extract combinations were recorded, *Tagetes erecta* L., *Zinger officinale* Roscoe, *Lantana camara* L. with 20% plant extract and 80% fungicide and *Cinnamomum* spp, *Kaempferia* spp. with 30% plant extracts and

70% fungicide when, the combine with 100% fungicide solution are effective to control *Ustilago scitaminea* in sugar cane cultivation. *Zinger officinale* Roscoe, *Cinnamomum* spp. plant extracts give better high effective than combine with 100% fungicide concentration.

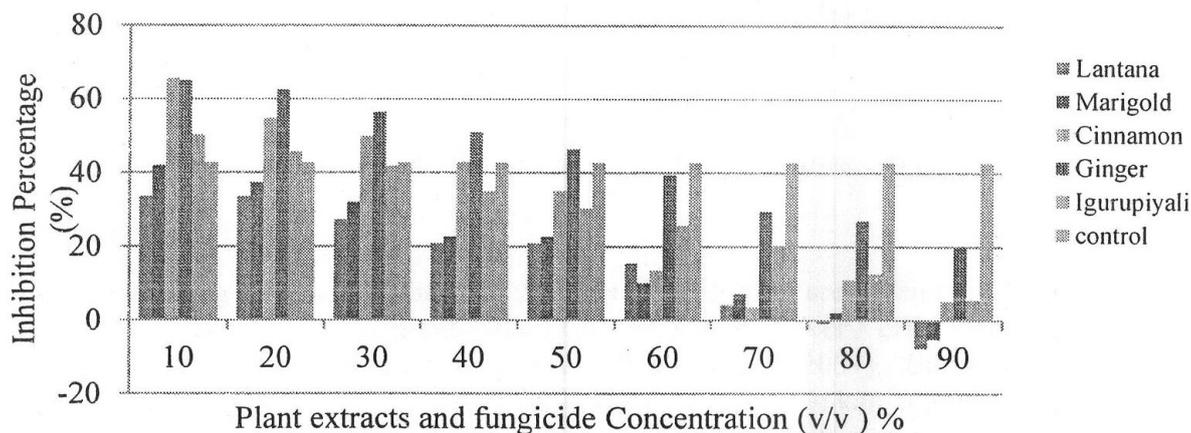


Figure 1. Graphical representation of different concentration combination of plant extracts with fungicide on growth of *Ustilago scitaminea* of sugarcane species

Conclusions

Five plant species, *Lantana camara* L., *Cinnamomum* spp, *Tagetes erecta* L., *Zinger officinale* Roscoe, *Kaempferia* spp. from twenty five plant species were effective to control sugarcane smut disease *Ustilago scitaminea*. All the most appropriate consideration percentage is good for to reduce the accumulation of the chemical in the eco system and human organization. As so far biological control method can evaluate as eco-friendly, cost effective method to control side effect from the chemical fungicide.

References

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