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Full Length Research Paper

Epidemiology of *Ustilago scitaminea* (Syd.): I. Collateral Hosts in Central Clay Plains of the Sudan

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A nursery experiment was conducted at the Sugarcane Research Centre, Guneid; (Lat. 15°N, long. 33°E) from 2007/08 to 2009/2010. The objectives were to determine the host range of *Ustilago scitaminea* (Syd.), the causal agent of sugarcane smut disease under conditions of the central clay plains of the Sudan. Members from the Poaceae 13 spp. (both crop and weed species); Cyperaceae 3 spp. and Typhaceae, a single species were tested by artificially inoculating by the dip method for vegetatively propagated subjects and moist seed contamination when seeds were used. In all the tested plant families and species, no single test plant species was infected. Thus, this imply a narrow host range for *Ustilago scitaminea* (Syd.) and tentatively, indicates that, weeds do not play any important role in the seasonal carry-over and perpetuation of sugarcane smut disease in the Central clay plains of the Sudan.

Keywords: Central clay plains; collateral hosts; epidemiology; sugarcane smut; Sudan, *Ustilago scitaminea*

INTRODUCTION

The role of collateral and/or alternative hosts in perpetuating plant diseases cannot be under estimated, and is well documented in most plant disease patho-systems. However, smut disease of sugarcane has not received equal attention in this area from many workers. Ferreira and Comstock (1989) collated a check list of some collateral hosts for *Ustilago scitaminea* (Table 1). Despite the fact that these hosts have been artificially inoculated and infected with success, this list is definitely incomplete. Chona and Gattani (1950) are of the opinion, and, considered *Saccharum spontaneum* to be the most potential source of infection for commercial sugarcane varieties in cane plantations. Elsewhere, some workers have also, achieved infection of hosts other than *Saccharum* spp. by the smut fungus utilizing artificial means (McMartin, 1945; Mundkur and Thirumalachar, 1952; Srinivasan and Alexander, 1965). However, Comstock and Lentini (1991) strongly stressed that although sugarcane smut has been reported on a few other members of the Poaceae, there are probably no important naturally occurring alternative hosts outside the *Saccharum* complex. Nevertheless, due to the occurrence of pathogenic races in different geographical locations and variations in environment, efforts are objectively being exerted to further explore for the occurrence/ presence of more possible hosts. According to Leu (1969) smut of sugarcane once disappeared into the wild in Taiwan for thirty years before recurring again on sugarcane the possibility was that it probably parasitized and lived on wild grass hosts before reverting back to sugarcane. This trial was therefore tentatively initiated to continue the search for possible hosts amongst some common plants and weed members of the Poaceae (Gramineae) and other plant families found in association with cane cultures and irrigation systems. They were subjected to artificial inoculation trials by the standard dip inoculation method DM a method known to be suitable under Sudan conditions (Marchelo-d'Raga and Bukhari, 2009).

Table 1: Plant species reported to be hosts of *Ustilago scitaminea* (Syd.) under experimental conditions.

Plant species artificially infected by *U. scitaminea* (Syd.)	Author
Saccharum interspecific hybrids	Ferreira and Comstock (1989)
Saccharum officinarum	Ladd and Heinz (1976)
Saccharum spontaneum	Ladd and Heinz 1976; Sydow (1924); Chona and Gattani (1950)
Saccharum robustum	Ladd and Heinz (1976); Srinivasan and Alexander (1965)
Saccharum edule	Ladd and Heinz (1976)
Saccharum barberi	Alexander and Rao (1981); Mundkur and Thirumalachar (1952)
Saccharum sinense	Alexander and Rao (1981); Srinivasan and Alexander (1965)
Narenga sp.	Srinivasan and Alexander (1965)
Sclerostachya fusca	Mundkur and Thirumalachar (1952)
Erianthus saccharoides	Mc Martin (1945)
Imperata arundinacea	Mc Martin (1945)
Rottboellia cochinchinensis	Latiza (1980)
Sorghum bicolor (S. vulgare)	Hutchinson (1972)
Zea mays	Hutchinson (1972); Hirschhorn, (1963)

Note: *Sorghum bicolor* (Hutchinson, 1972) and *Zea mays* (Hirschhorn, 1963) can produce symptoms when artificially inoculated but are not considered natural hosts

MATERIALS AND METHODS

A barrel experiment was conducted between from 2007/08 to 2009/2010 at the Sugarcane Research centre, Guneid; (Lat. 15^{o}N, long. 33^{o}E) to investigate for possible hosts of *Ustilago scitaminea* (Syd.) the causal agent of sugarcane smut disease within the Poaceae (Gramineae), Typhaceae and Cyperaceae plant families; these are usually weeds known to be associated with sugarcane plantations and irrigation canals. Some of the most common food crop plants were also included in the tests. The trial was conducted in cut-barrels which were filled with river soil or silt mixed with sand in the ratio of approximately 2:1. The trial was arranged in a randomized complete block design and replicated four times for each plant species tested.

Inoculation procedure

About 250 g seeds each of *Sorghum bicolor* cultivars, maize (*Zea mays*) and pearl millet (*Pennisetum glaucum*) etc. were soaked overnight in water in a 500 ml beaker in the laboratory. The water was carefully decanted and 2-5g smut spores was added to the wet seeds and carefully agitated until a uniform film of spores formed all over the seeds. These were then planted immediately in five holes/ barrel after complete germination and when seedlings were in the second leaf stage they were thinned to one plant/hole.

For the Cyperaceae, Typhaceae and other vegetatively propagated subjects within the Poaceae: 25 nuts were prepared (Cyperaceae); or whole clumps were dug out then carefully separated to give root pieces (rhizomes) with single shoots (Typhaceae); for “nageel” (*Cynodon dactylon* L.) 25 two node stem cuttings were prepared for the inoculation. These plant materials were then dipped in a spore suspension of 1 g smut spores/ litre water concentration for 15 to 20 minutes and planted singly, in (5 holes/ barrel) as above.

RESULTS AND DISCUSSION

Table 2 shows a list of plant species or suspected probable hosts of *Ustilago scitaminea* that were tested. Under the conditions of these trials we were unable to achieve any infection with *Ustilago scitaminea* of any of the test plants by artificial inoculation means, within Poaceae (13 spp.), Cyperaceae (3 spp.) and Typhaceae (*Typha latifolia*). Also, during some field excursions undertaken in and around cane fields, no single infection and symptom expression in the form of whips was observed within the sugarcane weed flora. These results are in agreement with the work of Hutchinson (1972) and Comstock and Lentini (1991) who elucidated that although several workers have reported successes in artificially inducing infection by *U. scitaminea* on some few other members of the grass family (McMartin 1945; Hirschhorn 1963; Hutchinson 1972) (Table 1). There are probably no economically important naturally occurring alternate/ alternative hosts outside the *Saccharum* complex. This therefore, implies that under the conditions of the central clay plains; the host range of *Ustilago scitaminea* is extremely narrow and confined only to the cultivated commercial hybrids of sugarcane

Table 2: A check list of plant species tested as collateral hosts for *Ustilago scitaminea* under Guneid conditions (Sudan)

Family	Scientific name	Local name(s)	NPT	NPI	PIP
Poaceae	*Cynodon dactylon*	Nageel	25	0/25	0
	Aristida adscensionis	Humra,Gaw	25	0/25	0
	Rottboellia cochinchinensis	Abu boelilah	25	0/25	0
	Sorghum arundinaceum	Adar	25	0/25	0
	Sorghum vulgare cv. Faterita	Eish, Dhura	25	0/25	0
	Sorghum vulgare cv. Abu Sabaeyin	”	25	0/25	0
	Sorghum vulgare cv. Jaraweia	”	25	0/25	0
	Sorghum vulgare cv. Haggeen	”	25	0/25	0
	Sorghum vulgare cv. Wad Ahmad	”	25	0/25	0
	Sorghum vulgare cv. Ta’abat	”	25	0/25	0
	Sorghum vulgare cv. Akkhar	”	25	0/25	0
	Sporobolus pyramidatus	Eish Elfar	25	0/25	0
	Setaria verticilata	Lussaig	25	0/25	0
	Chloris virgata	Kurmoshaiba	25	0/25	0
	Pennisetum glaucum	Dukhun	25	0/25	0
	Zea mays cv. Sennar local	Dhura Shamia	25	0/25	0
	Zea mays cv. Guneid local	”	25	0/25	0
	Saccharum spp. cv. CO 6806	Ghasab el Sukar	15 buds	2/15	13.3
	Saccharum spp. cv. NCO 376	Ghasab el Sukar	15 buds	13/15	86.7
	Saccharum spp. cv. CO 527	Ghasab el Sukar	15 buds	9/15	60
	Voccia cuspidata	Ghasab el moya	18 buds	0/18	0
	Phragmites austalis	El-boush	18 buds	0/18	0
	Ocimum spp.	Maherib	12	0/12	0
Cyperaceae	*Cyperus rotundus*	Se’ida	25	0/25	0
	Cyperus esculentum	Se’ida	25	0/25	0
	Cyperus polystachyos	Se’ida	25	0/25	0
Typhaceae	*Typha latifolia*	Umbrambeita	25	0/25	0

NPT: = Number of plants tested; **NPI:** = Number of plants infected; **PIP:** = Percentage of infected plants

or *Saccharum* spp. complex. Therefore, a sustainable management of this disease should incorporate a rigorous screening program to identify and broaden the spectrum of resistant/ tolerant genotypes to the disease, and to safe guard against possibly new emerging races of the pathogen supported by a strong breeding program.

CONCLUSIONS

The host range of *Ustilago scitaminea* (Syd.) was found to be extremely narrow, only genotypes within the cultivated *Saccharum* spp. were infected, and, none of the tested suspected probable hosts developed the characteristic smut symptoms/ sori often associated with infection by *Ustilago scitaminea*. Hence, seasonal disease carry-over is, therefore, confined to only within the cultivated hybrids of *Saccharum* spp. and weeds do not play any important role as an epidemiological factor in the perpetuation of the disease, in the central clay plains of the Sudan. A separate study is advised for the Southern states of the Sudan (now the Republic of South Sudan). This is due to the more humid climatic conditions there and diversity within the Poaceae including the presence of wild *Saccharum* spp.

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