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Fungal Organisms Associated with Common Tropical Weeds in Choba Rivers State Nigeria.

Organismos fúngicos asociados con malezas tropicales comunes en el estado de Choba Rivers, Nigeria

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ABSTRACT

The research was conducted to investigate fungal species associated with common tropical weeds in Choba, Rivers State of Southern Nigeria. Weed samples were collected from plots previously cropped with maize, soybean, cassava, aerial yam and plantain at the University of Port Harcourt, Teaching and Research Farm, Choba, Nigeria. The samples were chopped into pieces (5 mm), sterilized in 2% of sodium hypochlorite ($NaOCl$) solution for 2 mins, rinsed in three changes of sterile distilled water and thereafter placed on potato dextrose agar (PDA) and incubated at 28 ± 2°C in complete darkness for 5 days. Repeated sub-culturing was done to get pure cultures. These were identified microscopically and morphologically in line with standard techniques. A total of thirty-five weeds species, comprising of twenty-seven broadleaves, five grasses and three sedges were collected from the plots. Three fungal pathogens namely; *Aspergillus* spp, *Fusarium* sp, *Penicillium* sp known to produce toxins (aflatoxin, fumonisin and patulin, respectively), were isolated from the weed samples. Common weeds such as *Cyperus esculentus, Phyllanthus amarus* var *niruri and Panicum maximum* were all associated with the commonly isolated fungal pathogens. These weeds were well distributed across plots and therefore could serve as alternate host in the field and also pose serious risk on crop production and quality.

Key words: Weeds, fungal species, *Fusarium* spp, *Aspergillus* spp, *Penicillium* sp, *Cyserus esculentus*.

RESUMEN

La investigación se llevó a cabo para investigar las especies de hongos asociadas con malezas tropicales comunes en Choba, estado de Rivers en el sur de Nigeria. Se recolectaron muestras de malezas de parcelas previamente cultivadas con maíz, soya, yuca, ñame aéreo y plátano en la Granja de Enseñanza e Investigación de la Universidad de Port Harcourt, Choba, Nigeria. Las muestras se cortaron en trozos (5 mm), se esterilizaron en solución de hipoclorito de sodio (NaOCl) al 2% durante 2 min, se enjuagaron en tres cambios de agua destilada estéril y luego se colocaron en papa dextrosa agar (PDA) y se incubaron a 28 ± 2 °C en completa oscuridad durante 5 días. Se realizaron subcultivos repetidos para obtener cultivos puros. Estos fueron identificados microscópicamente y morfológicamente de acuerdo con las técnicas estándar. Se recogieron de las parcelas un total de treinta y cinco especies de malas hierbas, que comprenden veintisiete de hoja ancha, cinco gramíneas y tres juncias. Tres patógenos fúngicos a saber; *Aspergillus* spp, *Fusarium* sp, *Penicillium* sp conocido por producir toxinas (aflatoxina, fumonisina y patulina, respectivamente), se aislaron de las muestras de malas hierbas. Las malas hierbas comunes como *Cyperus esculentus*, *Phyllanthus amarus* var *niruri* y *Panicum maximum* se asociaron con los patógenos fúngicos comúnmente aislados. Estas malas hierbas estaban bien distribuidas en las parcelas y, por lo tanto, podrían servir como hospedantes alternativos en el campo y también representar un riesgo grave para la producción y la calidad de los cultivos.

Palabras clave: Malezas, especies fúngicas, Fusarium spp, Aspergillus spp, Penicillium sp, Cyserus esculentus.

INTRODUCTION

Weeds are the most underrated pests in crop production despite the fact that they cause higher reduction in crop yield than other pests and diseases (Das, 2013). A well reported data on the total annual loss of agricultural produce in some part of the world show that weeds account for 37%, insects (29%), diseases (22%) and other pests roughly account for 12% (Yaduraju, 2006). Weeds have always been and will be an important part of agricultural systems (Lovett and Knight, 1996). Three reasons why weeds must be removed include; economic, social and aesthetic reasons. It is of interest to know that weed species common to any ecosystem is proportional to the crop grown, management practices, environment, biotic and abiotic factors (Kumar, 2016). Studies have shown that fungi represent an exceedingly adaptable group of eukaryotic carbon-heterotrophic organisms that have effectively occupied nearly all-natural habitats (Knogge, 1996). Over the years weeds have been identified as alternative host for pathogens which has made plant pathogenic organism very difficult to manage (Hillocks, 1998). The high incidence of *Verticillium* wilt in cotton caused by *V. dahliae* in a field where cotton had not been cultivated for 15 years was ascribed to the presence of crowed weeds of *Ageratum conyzoides*, which was later identified as alternative host for *V. dahlia* (Hillocks, 1998). By inoculation, some common weeds found in cotton fields in Tanzania were infected with *Fusarium* wilt pathogen caused by *Fusarium oxysporum f.sp. vasinfectum* (Wood and Ebbels, 1972).

Pseudomonas solanacearum which is the causal agent of bacterial wilt in a wide variety of crops has been isolated severally from weed species belonging to members of the *Solanaceae* and *Asteraceae* (Hayward, 1994). A lot of research has been conducted on the association of fungal pathogens with crops in southern part of Nigeria

(Baiyewu *et al*., 2007; Bukar *et al*., 2009; Zubbair, 2009; Chukwuka *et al*., 2010 and Akintobi *et al*., 2011) but very little is done with reference to weed-fungi association in this zone. In order to provide baseline data for future research, this work will investigate the diversity of fungal pathogens associated with common tropical weeds of arable crops in southern Nigeria.

MATERIALS AND METHODS

Experimental site: The experiment was conducted at the University of Port Harcourt, Teaching and Research Farm, Choba, Rivers State, Nigeria. The area lies within the tropical rainforest belt between Latitude 04^o 54' 539' N and Longitude 006^o 55' 330' E. The rainfall pattern of the area is bimodal with a long rainy season usually occurring between March and July and a short rainy season from September to early November (Akande *et al*., 2010). The site is characterized by an average temperature of 27^{o}C, relative humidity of 78% and an average rainfall that ranges from 2500 – 4000 mm per annum.

Collection of samples: Thirty-five (35) weed species were randomly collected from plots previously cropped with Maize (*Zea mays*)*,* Soya bean (*Glycine max*)*,* Aerial yam (*Dioscorea bulbifera*)*,* Cassava (*Manihot esculenta*) and Plantain (*Musa paradisiaca*), identified with reference to Akobundu *et al*. (2016). The weeds were put into sterile polythene bags and taken to the laboratory for analysis.

Fungal isolation and identification: Samples of weeds were sterilized in 2% sodium hypochlorite (NaOCl) solution for 1 minute, rinsed in three changes of sterile distilled water and blotted dry on a sterile Whatman paper in laminar flow chamber for 10 minutes. Small sections of about 5mm of weed samples were cut and plated aseptically in Petri dishes containing potato dextrose agar (PDA) modified with streptomycin (100 mg L^{-1}). The plates were incubated for 5 days at 28 ± 2°C in complete darkness and monitored daily. Pure cultures were gotten from developing fungal colonies by repeated sub-culturing. Fungal colonies were identified microscopically and morphologically with reference to the Manual of Fungal Atlas (Watanabe, 2002).

RESULTS AND DISCUSSION

Weed species incidence: A total of thirty-five weeds species, including twenty-seven broadleaves, five grasses and three sedge weed species were reported from different arable plots of the University of Port Harcourt, Teaching and Research Farm, during 2016/2017 planting season. Table 1 shows weed species incidence across arable fields previously cropped with *Zea mays, Glycine max, Dioscorea bulbifera, Manihot esculenta* and *Musa paradisiaca*. It was observed that *Commelina benghalensis*, *Phyllanthus amarus* var *niruri*, *Cyperus esculentus* and *Panicum* *maximum* were the dominant weed species because of their high incidence in all the plots previously cropped with the five arable crops under investigation.

In this our study, the most abundant weed species type or flora was the broad leaves, followed by the grasses and the sedges. This observation is in agreement with Takim *et al.,* (2014) whose report had high incidence of broadleaved weeds in most arable crops, followed by the grasses while the sedges came close to the grasses with the least incidence. However, our result was in sharp contrast to the report of Ndarubu *et al*., (2006), who identified grasses to be of highest density, closely followed by the broadleaved weeds, while the sedges had the lowest density in a survey conducted in Ilorin, Nigeria. The difference in the result could be attributed to the fact that their result was gotten from sugarcane plots only as well as being in the Northern Guinea Savannah ecology in contrast to the Southern Nigeria where this study was conducted. The contrasting ecologies might explain the observed variation in flora dominance. High incidence of broadleaved weed species in our study could be attributed to the fact that the plots were previously cropped with more broadleaved crops which may also have shaded the grasses and the ability of most of the weed seeds to stay in a dormant state for a long period of time and seed dispersal was through various mechanisms (Akobundu, 1987). Rain fed or natural fields are higher in species richness than irrigated fields. This difference in weed species emergence and magnitude could be as a result of environmental conditions, namely moisture regime (Marginet *et al.,* 2000), as well as the dominant size and previous weed seed bank floral.

Fungal pathogens associated with the common weeds: The present study revealed the fungal pathogens associated with common weeds found in Choba, Rivers State in Southern Nigeria (Table 2). Four major fungal species viz: *Aspergillus spp, Fusarium* sp*, Penicillium* sp and *Rhizopus* sp were commonly isolated from these weed species. Although, the importance of weeds to mankind cannot be over emphasized because of their usage as a source of secondary food, medicine, insecticide and other uses (Hillocks, 1998), they are also host to many fungal pathogens (Gail and Robert, 2005). Three out of the four fungal species (*Aspergillus* spp*, Fusarium* sp*, Penicillium* sp) isolated and identified from this study are commonly known to produce toxins (Raed *et al*., 2016), so as aflatoxin produced by *Aspergillus* and this agrees with previous studies by Jimoh and Kolapo, (2008) whose result showed that *Aspergillus* sp isolated from groundnut and yam chips produced high level of toxins. *Fusarium* infection and contamination is a major problem in Nigeria and the prevalence of *Fusarium* sp in this study is in agreement with Wokoma (2008) who isolated *Fusarium* spp from plant and soil samples in Choba area. Obire and Wemedo (2002) had earlier isolated *Aspergillus spp, Penicillium* sp and *Rhizopus* sp from soils in Rivers State. In the midst of the likely disadvantages of weeds/crops coexistence, disease risk may increase if weeds are hosting pathogens (Dentika *et al*., 2021). These weeds can infect many weed species in the fields and cause yield loss. They nevertheless showed potential for concentration toward preferential hosts, with these fungi demonstrating a tendency to occur on plants with creep or climbs. These prevalence rates are suggesting high potential for weeds as inoculums sources and disease start. Weeds may nevertheless play an important role in disease initiation (Gilbert, 2002), especially since they are still present in the fields while crops are not after harvest. They seem to relay disease via host skill both within fields and increase prevalence via interaction with crops at the neighborhood. It is evident from our study that a symbiotic relationship existed between the fungi species and weeds which is in total agreement with previous reports by Martin *et al*., (2011) and Martin *et al*., (2018) on the dawn of symbiosis between plants and fungi. These pathogenic fungi are capable of surviving in the host absence by alternatively living on weeds or living as saprophytes on crop residues while waiting for the onset of another cropping season (Agrios, 2005).

Table 1. Weeds collected from University of Port Harcourt Teaching and Research Farm in the 2016/2017 cropping season

			Previously cropped plots				
Family	Common name	Botanical name	Maize	Soybean	Cassava	Aerial yam	Plantain
Amaranthaceae	Sessile joy weed	*Alternanthera sessilis*	-	+	-	-	-
Asteraceae	Node weed	*Syndrella nodiflora*	+	+	-	-	-
	African bonebract	*Sclerocarpus africanus*	+	-	+	-	-
	Tridax	*Tridax procumbens*	-	-	+	-	-
	Goat weed	*Ageratum conyzoides*	-	-	+	+	-
	Haemorrhage plant	*Aspilia Africana*	-	-	+	+	-
	Siam weed	*Chromolaena odorata*	-	-	+	-	-
	Tassel flower	*Emilia praetermissa*	-	-	-	+	-
Cleomaceae	Fringed spider flower	*Cleome rutidosperma*	-	+	-	+	-
Commelinaceae	Tropical spiderwort	*Commelina benghalensis*	+	+	+	+	+
Connaraceae	Ogbakpee	*Cnestis ferruginea*	-	-	+	-	+
Convolvulaceae	Morning glory weed	*Ipomoea involucrata*	+	+	+	+	+
Cyperaceae	Yellow nutsedge	*Cyperus esculentus*	+	+	+	+	+
	Umbrella papyrus	*Mariscus alternifolius*	-	-	+	-	-
	Purple nutsedge	*Cyperus rotundus*	+	-	+	+	+
Euphorbiaceae	Australian asthma plant	*Euphorbia hirta*	+	+	-	-	+
	Spurge weed	*Euphorbia heterophylla*	+	+	+	+	-
	Stone breaker	*Phyllanthus niruri*	+	+	+	+	+
Fabaceae	Centro	*Centrosema pubescens*	+	-	-	-	-
	Calopo	*Calopogonium mucunoides*	+	+	-	+	+
	Sensitive plant	*Mimosa pudica*	+	-	-	-	+
Lamiaceae	Pig nut	*Hyptis suaveolens*	-	-	+	-	-
Loganiaceae	Worm bush	*Spigelia anthelmia*	+	-	-	-	+
Malvaceae	Wire weed	*Sida acuta*	+	+	-	-	-
Poaceae	Bermuda grass	*Cynodon dactylon*	+	+	+	-	+
	Guinea grass	*Panicum maximum*	+	+	+	+	+
	Goose grass	*Eleusine indica*	+	+	-	-	+
	carpet grass	*Axonopus compressus*	-	+	-	+	+
	Signal grass	*Brachiaria deflexa*	-	-	-	-	+
Portulacaceae	Common purselane	*Portulaca oleracea*	-	-	+	+	-
Rubiaceae	Diamond flower	*Oldenlandia corymbosa*	-	-	-	+	-
	Girdle pod	*Mitracarpus villosus*	+	+	-	-	-
	False buttonweed	*Spermacoce ocymoides*	+	-	-	-	+
Scrophulariaceae	Sweet broom weed	*Scoparia dulcis*	+	+	+	-	+
Verbenaceae	Blue rat's tail	*Starchytarpheta cayennensis*	+	-	+	+	+

+ Present; - absent

Table 2: Fungi species associated with common weeds collected from the University of Port Harcourt Teaching and Research Farm in the 2016/2017 cropping season

Associated organism						
Weed species	Common name	Family	*Aspergillus* spp	*Fusarium* sp	*Penicillium* sp	*Rhizopus* sp
Alternanthera sessilis	Sessile joy weed	Amaranthaceae	+	+	+	+
Syndrella nodiflora	Node weed	Asteraceae	+	+	+	+
Sclerocarpus africanus	African bone bract	Asteraceae	+	-	+	+
Tridax procumbens	Tridax	Asteraceae	+	-	+	+
Ageratum conyzoides	Goat weed	Asteraceae	+	-	+	+
Aspilia Africana	Haemorrhage plant	Asteraceae	+	-	+	-
Chromolaena odorata	Siam weed	Asteraceae	+	-	+	+
Emilia pratermissa	Tassel flower	Asteraceae	+	-	+	-
Cleome rutidosperma	Fringed spider flower	Cleomaceae	+	-	+	+
Commelina benghalensis	Wandering jew	Commelinaceae	+	-	+	+
Cnestis ferruginea	Ogbakpee	Connaraceae	+	-	+	-
Ipomoea involucrate	Morning glory weed	Convolvulaceae	+	-	+	+
Cyperus esculentus	Yellow nutsedge	Cyperaceae	+	+	+	+
Mariscus alternifolius	Umbrella papyrus	Cyperaceae	-	-	+	-
Cyperus rotundus	Purple nutsedge	Cyperaceae	+	-	+	+
Euphorbia hirta	Australian asthma plant	Euphorbiaceae	+	-	+	-
Euphorbia heterophylla	Spurge weed	Euphorbiaceae	+	+	+	+
Phyllanthus niruri	Gale of the wind	Euphorbiaceae	+	+	+	+
Centrosema pubescens	Centro	Fabaceae	+	+	+	+
Calopogonium mucunoides	Calopo	Fabaceae	-	+	+	+
Mimosa pudica	Sensitive plant	Fabaceae	+	-	+	-
Hyptis suaveolens	Bush tea	Lamiaceae	+	+	-	-
Spigelia anthelmia	Worm bush	Loganiaceae	+	+	+	+
Sida acuta	Wire weed	Malvaceae	-	-	+	+
Cynodon dactylon	Bahama grass	Poaceae	+	-	+	+
Panicum maximum	Guinea grass	Poaceae	+	+	+	+
Eleusine indica	Goose grass	Poaceae	+	-	+	+
Axonopus compressus	Carpet grass	Poaceae	+	-	+	+
Brachiaria deflexa	Signal grass	Poaceae	-	-	+	-
Portulaca oleraceae	Common purselane	Portulaceae	+	+	+	+
Oldenlandia corymbosa	Diamond flower	Rubiaceae	+	-	+	-
Mitracarpus villosus	Girdle pod	Rubiaceae	-	+	+	-
Spermacoce ocymoides	False button weed	Rubiaceae	+	+	+	+
Scoparia dulcis	Sweet broom weed	Scrophulariaceae	+	-	+	-
Stachytarpheta cayennensis	Blue rat's tail	Verbenaceae	+	-	+	+

+ Present; - absent

CONCLUSION

This study has revealed that weeds could habour toxigenic strains of fungi which when consumed as herbs could be poisonous to the health of humans and animals. Since weeds are a major source of nutrition to livestock and a supplementary source of food to man in southern Nigeria, this study becomes vital to both human and animal nutrition. Therefore, as alternative hosts of fungal pathogens, and particularly how this interaction will be of benefit to crop production, this should be given optimal attention in southern Nigeria. The knowledge of the nature and extent of contamination of weed flora in fields used for arable crop production will be essential in formulating relevant disease and weed control strategies to boost crop productivity and quality.

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