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Research Note

A Survey on Epidemiology of Virus Diseases of Benniseed (*Sesamum indicum* L.) in Northern Nigeria

Abo, M. E.[1], Afolabi, A. S.[2], Ayodele, M.[3] and Onwughalu, J. T.[1]
[1]National Cereals Research Institute,Badeggi, P.M.B. 8, Bida, Nigeria
[2]Sheda Science & Technology Complex (SHETSCO), Sheda - Abuja, Nigeria.
[3]International Institute of Tropical Agriculture (IITA), P.M.B. 5320 Ibadan, Nigeria
Corresponding Author E-mail: meabo2018@gmail.com

Abstract
A Survey commissioned by the International Institute of Tropical Agriculture (IITA) and financed by the Nigerian Plant Quarantine Services (NPQS) was conducted between 2009 and 2010 to investigate common virus diseases of Benniseed (*Sesamum indicum*L.) in some States of Northern Nigeria. The assessment was based on descriptive survey of the virus disease incidence and distribution on a farmersfield in nine states including; Benue, Kogi, Nasarawa, Kaduna, Plateau, Bauchi, Gombe, Katsina, and Jigawa. Disease identification and characterization was based on typical visual symptoms of the viruses in line with International Plant Protection Committee (IPPC). *Tobacco leaf curl virus* (TLCV) was common disease of *S. indicum* in the States. The highest record of the TLCV incidence was obtained in Benue State, where seven out of nine farmers' fields surveyed were found with the virus disease symptoms. Three fields were found with TLCV symptoms in Kogi State, whereas four fields were found with the disease symptoms in Nasarawa and Bauchi States. The TLCV was similarly intercepted in two fields in Gombe, and five in Jigawa States. *Tomato yellow leaf curl virus* (TYLCV) disease was however encountered in one field each in Kaduna, Bauchi and Jagawa States, whereas the disease symptoms were found in two fields in Katsina State. The recommended management practices for TLCV and TYLCV include the use of resistant or tolerant varieties, maintenance of weed free fields, destruction of crop residues after harvest, rouging of the virus infected plants and burning or burying them in the soil outside the field, spray of appropriate insecticide to control or prevent insect-vector outbreak, as well as use of integrated pests management strategy. Further epidemiology studies as well as biological, serological and molecular characterization of the viruses is also strongly recommended.

Keywords: Incidence, TLCV, TYLCV, Sesame, Nigeria

Introduction

Sesame (*Sesamum inidicum* L.) is an important oilseed crop cultivated in the derived Northern Guinea Savannah, Sudan and Sahel Savannah vegetation Zones of Nigeria (Alegbejo *et al*., 2003). Sesame belongs to the division spermatophyte and family *Pedaliacea*, and believed to have originated from tropical Africa. It is probably the most ancient oilseed crop known and used by man (Weiss, 1971). It is popularly called benniseed in Nigeria while the name 'Sesame' is used worldwide. Sesame is also known as 'simsim' in East Africa and 'till' in India. The Hausa, Ibo and Yoruba tribes of Nigeria call it 'ridi' 'ekuku', and 'isasa', respectively. Sesame is an important export crop in Nigeria (Ali, 2015), which plays a substantial role in the global sesame trade.

The plant is usually 60 to 120 cm tall and the fruit is a dehiscent capsule held close to the stem.

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When ripe, the capsule shatters to release a number of small seeds. The seeds are protected by a fibrous 'hull' or skin, which may be whitish to brown or black depending on the variety. 1000 seeds weigh about 4 to 8g. The plant is deep rooting and well adapted to withstand dry conditions. It will grow on relatively poor soils in climates generally unsuitable for other crops (Hamman, 1998)and so it is widely valued for its nutritional and financial yield from otherwise inclement areas. It is well suited to smallholder farming with a relatively short harvest cycle of 90 to140 days allowing other crops to be grown in the field. It is often intercropped with other grains. The total world crop area under sesame is about 6 million hectares (Uzo, 1998), with sixty-six percent of this being found in Asia (India, China and Burma) twenty-five percent in Africa and eight percent in America (Venezuela, Mexico, Guatemala and Colombia). Sesame has become a commercial crop, with its production and demand in Nigeria on the increase due to its use in homes and industries (Alegbejo *et al.*, 2003; Adole, 2016). The crop has a high potential as a source of raw material from which high-grade oil, animal feeds, confectionaries, soap and paints are derived. In Nigeria, it has become a common venture among rural communities to prepare soap from sesame and its by-products, especially the women groups. The cake resulting from the processing of sesame seed contains a high protein level close to that of soybean; in addition to its high methionine content making it useful for livestock feeds (Onaihor *et al*., 2018). Sesame seeds are processed and utilized for the production of high quality edible oil for cooking, salad, margarine, and iodized oils (Uzo,1998). It is valuable in the pharmaceutical industries (Njoku *et al.*, 2010). The Tiv people also eat the porridge with boiled yam. The seed is used as candy, fried and mixed with honey or sugar, left to settle and dry into a solid form. The semi drying oil is a substitute for olive oil for controlling bacterial infections on umbilical cord of newly born babies (Njoku *et al*.,2010). Other uses for medical purpose include the treatment of dysentery, diarrhea, ulcers, and sores.Sesame is known to be attacked by *Tobacco leaf curl virus* (TLCV), Geminivirus / carlavirus (White fly, graft transmission), and *Tomato yellow leaf curl virus* (TYLCV), Geminivirus (White fly) worldwide (Kabeh, 2017). TLCV occurs mainly in tropical and sub-tropical regions, but it is also reported in temperate regions (Japan and parts of Europe and USA). TLCV is destructive to tobacco and other hosts in tropical countries (Valand and Muniyappa, 1992). Because the natural host plants are numerous, the virus can infect hosts and spread rapidly via the vector. The whitefly (*Bemisiatabaci)* is the most important vector (Bird and Maramorosch, 1978). Whiteflies can transmit the virus after a 30 minutes acquisition access period and a 60 minute inoculation access period (Sugiura *et al.,* 1975; Osaki *et al.*,1977).The minimum latent period in the vector is between 4 and 9 hours, depending on the length of the acquisition access period (Sugiura *et al.,* 1975; Osaki *et al.,* 1977). TLCV is retained by the vector for more than 12 days (Sugiura *et al.,* 1975), 16 days (Osaki *et al.,* 1977) or life (Varma, 1963). There is no evidence that the virus multiplies in the vector, the virus has also not been transmitted by inoculation with sap.Transmission through seed is not yet reported; and the virus is not transmitted by dodder – *Cuscutacampestris* (T. Osaki, unpublished data). *Tobacco leaf curl virus* (TLCV) is a plant pathogenic virus of the family *Geminiviridae*. Particles are geminate structures measuring 15-20 x 25-30 nm. Geminiviruses belong to an economically important family of plant viruses that are characterized by having small circular single-stranded DNA (ssDNA) genomes, encapsidated in twinned icosahedral particles (Lazarowitz, 1992). The *Geminiviridae* family consists of four genera that differ with respect to insect vector, host range and genome structure (Fauquet *et al*., 2000). The genus *Begomovirus* represents the whitefly-transmitted, dicot-infecting geminiviruses commonly with bipartite genomes consisting of two ssDNA components, designated DNA A and DNA B. Some begomoviruses, however, have a single genomic component (Dry *et al*., 1993; Noris *et al*., 1994). TLCV may be distinguished from two other whitefly-borne viruses with geminate particles, *Tomato yellow leaf curl* (Cohen and Nitzany, 1966; Russo *et al.,* 1980) and *Tomato golden mosaic* (Matyis *et al.,* 1975) because tomato yellow leaf curl virus has a much longer period of

latency (21 hours at least) and progressively loses infectivity in the vector white fly (Cohen and Nitzany, 1966), and *Tomato golden mosaic virus* is transmissible by inoculation with sap (Costa, 1976). The virus may also be distinguished from other *Bemisiatabaci*-transmitted viruses that infect solanaceous plants, such as *Tomato yellow mosaic virus* in Venezuela and India, because they cause mosaic in tomato and tobacco (Verma *et al.*, 1975). However, information on the interrelationships of these viruses is still fragmentary and further work to compare them serologically and in other ways is desirable. Sesame is also popular in northern Nigeria; hence the present study was to investigate the common virus diseases of Benniseed (*Sesamumindicum*L.) in some northern States of Nigeria.

Materials and Methods

The field survey was carried out between 2009 and 2010 in nine sesame growing states including; Benue, Kogi, Nasarawa, Kaduna, Plateau, Bauchi, Gombe, Katsina, and Jigawa.The surveywas based on common virus diseases of Benniseed (*Sesamumindicum*) between 2009 and 2010. Sesame farms were chosen at random across the states and monitored for virus symptoms. Disease identification and characterization was based on typical visual symptoms of the viruses in line with International Plant Protection Convention (IPPC) and Food and Agricultural Organizatio (FAO) guidelines on surveillance. Three farmers field chosen at random were investigated from each of the nine States and geo-referenced with Geographic Positioning System (GPS). Information about the farms and cultural practices engaged by farmers was obtained using questionnaires. Typical viruses like symptoms encountered in the fields were photographed (Plates 1 – 3). The samples were collected in sample envelopes and stored under room temperature for further analysis.

Results and Discussion

Tobacco leaf curl virus (TLCV) was widespread across the states with only one record of *Tomato yellow leaf curl virus* (TYLCV) disease in farmer's field in Kaduna State (Table 1). The assessment of virus disease incidence in farmers'Benniseed fields in five state (Benue, Kogi, Nasarawa, Kaduna and Plateau), this indicated that *Tobacco leaf curl virus* (TLCV) was common disease of Benniseed (*Sesamum indicum*) in the area (Table 1). The highest record of the TLCV was obtained in Benue State, where seven (7) out of nine surveyed fields were found with the disease symptoms. Three fields were found with the TLCV in Kogi State, five in Nasarawa State. TLCV caused leaf curling and some plants attacked appeared bunchy (Plates 1, 2 and 3). Some of the recommended management practices for the viruses include the destruction of crop residues after harvest, use or resistant or tolerant varieties, and maintenance of weed-free fields. It is also important to rogue TLCV or TYLCV infected plants and destroy them by burning or burying them in the soil outside the field. Fields could be sprayed with appropriate insecticides to control or prevent insect outbreak, which usually will serve as vectors in transmitting the viruses. Moreover, use of integrated pest and disease management strategy are highly recommended in hot-spot zones. The result of this survey will enable theNational Plant Protection Organization and Nigerian Agricultural Quarantine Services to fulfil the phytosanitary obligations as required by the IPPC for certification and upgrade their import and export regulations in compliance with IPPC standards.

Conclusion

The present study has reported common viruses of sesame in northern Nigeria to include as *Tobacco leaf curl virus* (TLCV) and *Tomato yellow leaf curl virus* (TYLCV). The incidence of TLCV is however more than that of TYLCV. The recommended management practices for the viruses include the use of tolerant varieties, maintenance of weed free plots, destruction of crop residues after harvest, rouging of the virus infected plants and burning or burying them in the soil outside the field. Further epidemiology studies as well as biological, serological and molecular characterization of the viruses is also recommended.

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Table 1. Sesame Virus Disease Survey in nine States of Nigeria

States	Selected LGAs	Farmers' Names	Village Name	Plant Virus Disease Intercepted*	Coordinates	
					Latitude	Longitude
Benue	Gwer East	OLAM	MbaapenAbah	TLCV	7.272989	8.301965
	Gwer East	AmandeApine	TyiavWa	TLCV	7.396237	8.580763
	Gwer East	AngbiandooAzenda	Taraku	TLCV	7.267797	8.28058
Benue	Otukpo	Ijirbo James	Okete	TLCV	7.277409	8.196739
	Otukpo	AmehOgwuche	Entinna	TLCV	7.217797	8.197536
	Otukpo	OgboleEliagu	Okete	TLCV	7.271943	8.184377
Benue	Guma	OLAM Nig. Ltd	GberNyiev	None	8.207441	8.577067
	Guma	TerkendeUmase	Ingbian	None	7.929809	8.580072
	Guma	GbkughShagba	Yelewata	TLCV	8.148389	8.587395
Kogi	Dekina	KadiriAkowe	Ajekelaga	None	7.559438	7.635183
	Dekina	MeligaAtuluku	Ajekelaga	TLCV	7.580561	7.025507
	Dekina	Alh. Shaibu Ibrahim	Ajenego	TLCV	7.670237	7.084838
Kogi	Ankpa	Rev. AmoduIsreal	Emere	None	7.57462	7.025607
	Ankpa	Alh. Omale	Ofugo	None	7.467489	7.633345
	Ankpa	ShaibuOdidi	Inye	None	7.556383	7.614026
Kogi	Ofu	Deacon John Ugbaje	Ofoke	None	7.406752	6.779054
	Ofu	Atayi Musa	Ofogede	TLCV	7.378626	6.771245
	Ofu	Simon Ukwubile	Obubu	None	7.365532	6.771245
Nasarawa	Doma	HarunaAgbo	Doma	TLCV	8.433024	8.392841
	Doma	Terwase Solomon	Kawo	None	8.44488	8.41019
	Doma	Patrick Afi	KawoDoma	TLCV	8.445058	8.408647
Nasarawa	Obi	LimanOkoku	AlaguAbagu	TLCV	8.332218	8.731626
	Obi	Obadiah Illa	Agwade	None	8.451533	8.643596
	Obi	Ajeh Aba	Agwade	TLCV	8.452624	8.660939
Nasarawa	Lafia	AkushiyiAanyi	Assaikio	None	8.610283	8.864834
	Lafia	John Kigbu	ArahoDoma	None	8.469629	8.61379
	Lafia	Moh'dBabangida	BakinRijiya	TLCV	8.536486	8.61791
Kaduna	Jaba	Daniel Kura	GidanKundi	None	9.441044	7.954072
	Jaba	Felicia David	GidanKundi	TYLCV	9.443833	7.94858
	Jaba	Hanatu Jock	GidanKundi	None	9.441044	7.954072
Kaduna	Sanga	Adamu Ali	Ung. A. Kundi	None	9.419136	8.562942
	Sanga	Adamu Ali	Ung. A. Kundi	None	9.419041	8.562255
	Sanga	YakubuAdamu	Ung. A. Kundi	None	9.418232	8.56318
Kaduna	Jema'a	Kaduna Ishaku	Ung. M. Takau	None	9.576753	8.304073
	Jema'a	Awodi Joshua	ZikpakTakau	None	9.582498	8.317403
	Jema'a	Yakubu Musa	Takau	None	9.581958	8.317741
Plateau	BarkinLadi	Lyop Musa	B/Ladi Town 1	None	9.535221	8.907221
	BarkinLadi	Fom Isaiah	B/Ladi Town 2	None	9.535229	8.901385
	BarkinLadi	Abubakar Ahmed	Dorawa	None	9.517123	8.976942
Plateau	Shendam	Goproom Jacob	Shinkwan	None	8.894258	9.518453
	Shendam	Justina T. Bolang	Shinkwan	None	8.894258	9.518453
	Shendam	Esther Daniel	Longvel	None	8.865668	9.518453

Table 1.Contd

States	Selected LGAs	Farmers' Names	Village Name	Plant Virus Disease Intercepted*	Coordinates	
					Latitude	Longitude
Bauchi	Ganjuwa	MurtalaAliyu	KafinKawu	TYLCV	10.35664	10.34641
	Ganjuwa	MalamAmaduAyuba	Sabonko-Naka	TLCV	10.3662	10.34671
	Ganjuwa	AbdullahiAhmadu	Sabonko-naka	None	10.36586	10.35485
Bauchi	Ningi	M. Amadu	GorgarenMaje	TLCV	9.728814	10.18837
	Ningi	UbandiYakubu	Ningi	None	9.862796	9.427397
	Ningi	Musa Saidu	Zidanga	TLCV	NA	NA
Bauchi	Misau	AlhajiLadan	Abba Yayawo	TLCV	NA	NA
	Misau	Mal. AdamuMusau	Misuu	None	NA	NA
	Misau	MalamAbdulkadir	Misuu	None	NA	NA
Gombe	Bililri	Musa Ibrahim	Tal	None	NA	NA
	Bililri	NmadiDayi	Tanzi	None	NA	NA
	Bililri	Alh. Umaru M. Fawu	Awai	TLCV	NA	NA
Gombe	Kaltungo	HRH. HabilaGarba	TurePandi	None	NA	NA
	Kaltungo	Mrs Zuwanba Caleb Lamyi	Kalorey	None	NA	NA
	Kaltungo	Ibrahim Kalatan	Kalaran	TLCV	NA	NA
Jigawa	Birnin-kudu	LimanBabadou	Kiyako	TLCV	11.42497	9.492659
	Birnin-kudu	AbdulrahmanYakubu	Babadou	TLCV	NA	NA
	Birnin-kudu	Ibrahim Maishanu	Irbil	None	NA	NA
Jigawa	Gwaram	Alh. UmaruDanbatta	Gwaram	TLCV	11.42609	9.491015
	Gwaram	Alh. Ibrahim Maingwa	Zanda	TLCV	11.27701	9.797316
	Gwaram	Mal. InuwaGwaram	SabonGarinGwaram	TLCV	11.27475	9.797345
Jigawa	Dutse	AmaduUbale	Gida-ihuSjiwaro,	None	11.6944	9.528690
	Dutse	Mohammadu Saibu	DanmasraDiitse	TYLCV	11.70158	9.540055
	Dutse	SakirBayero	Laraba	None	11.34514	9.64189
Katsina	Charanchi	Yusuf Abdullahi	Charanchi 1	TLCV	NA	NA
	Charanchi	Yusuf Abdullahi	Charanchi 2	None	NA	NA
Katsina	Batagarawa	Alh. Gambo A. Bakiyawa	Bakiyawa	None	NA	NA
	Batagarawa	Alh. Gambo A. Bakiyawa	Bakiyawa	None	NA	NA
	Batagarawa	Alh. LawalHiyasu	Katoge	TLCV	NA	NA
Katsina	Rimi	UmaruPaduma	Paduma	TYLCV	NA	NA
	Rimi	DahiruLiman	TudunKadir	None	NA	NA
	Rimi	SaiduMaigaadi	Abukur	TYLCV	NA	NA

LGA = Local Government Areas, *****Visual Assessment, NA -= Not Available-

Plate 1. *Tobacco leaf curl virus* disease Symptoms on Sesame in Nasarawa State, Nigeria

Plate 2. *Tobacco leaf curl virus* disease on Sesame Plants in Katsina State, Nigeria.

Plate 3: *Tobacco leaf curl virus* disease on Sesame Plants in Benue State, Nigeria