ISOLATION AND OCCURRENCE OF SEED BORNE FUNGI ASSOCIATED WITH TOMATO, OKRA AND PEPPER SEEDS.

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Abstract

A laboratory experiment was carried out to isolate seed borne fungi from seeds of tomato, pepper and okra obtained from Lapai, Mokwa, Suleja, Paiko, Kontagora and Borgu Local Government Areas of Niger State. Potato Dextrose Agar (PDA) medium and Standard Blotter Papers methods were used to isolate the seed borne fungi from sterilized and unsterilized seeds of the selected vegetable crops. The total of 16 fungal species belonging to 5 genera was isolated from sterilized and unsterilized seeds. Borgu Local Government Area yielded highest number of fungal species with 98.00% (okra) from unsterilized seeds whilst sterilized seeds had 64.25% (okra). Similarly, Standard Blotter Papers also had 72.25% (tomato) from unsterilized seeds whilst sterilized seeds recorded 49.25% (tomato). Mokwa Local Government Area had the least incidence of fungi with 42.75% (okra) from unsterilized seeds on PDA medium, whilst sterilized had 25.25% (okra). The Standard Blotter Papers had 31.75% (pepper) from unsterilized whilst sterilized seeds had 21.75% (pepper). The most commonly genera were Aspergillus, Mucor, and Penicillium most of the fungi on unsterilized seeds were considerably reduced in a sterilized seeds both on PDA medium and Standard Blotter Papers.

Keywords: Seed borne fungi, vegetables, occurrence, standard blotter paper, potato dextrose agar medium

INTRODUCTION

Vegetables supply most of the nutrients that are deficient in other food materials. This include supply of minerals especially calcium and iron. Vegetables prevent constipation and promote digestion as a result of fibres/roughages obtained from Okra, *Amaranthus* etc. In Nigeria, vegetables are important source of vitamins and minerals for rural population as many nutritional studies have shown (Mnzava *et al.*, 1999). Vegetables are used in sauces, soups, stews and generally as a flavouring agent (Amusa *et al*., 2004). Vegetables provide income for women and children who cultivate it in large qualities (Amusa *et al*., 2004). Vegetables are generally needed to have balanced diets and overcome nutritional deficiencies. Trading of some vegetables was mainly local but is slowly changing to a regional and event international trade, especially tomato, *Amaranthus*, pepper and other fresh vegetables (Lapido *et al*., 1997). Vegetables production in certain areas in Nigeria is inefficient and little attention is paid to produce for efficient marketing systems. About 90% of the world food crops including pepper, tomato and okra are propagated by seed (Maude, 1996). Seeds are the passive carriers of some important seed borne diseases caused by microorganisms which usually result in considerable yield losses. Fungi, bacteria, viruses and nematodes can be carried with, on or in seeds. Seed borne diseases caused primarily by fungi do not only pose a major challenge to food security of toxin production by the microbes. Fungi are able to utilize the nutrients of seeds of vegetable and may cause deterioration and decay. According to Singh and Sharma (2007) seeds contain high levels of sugars and nutrients elements and then low pH values make them particularly desirable to fungi decay. It has been estimated that there are over 10, 000 fungi whose spores may become airborne (Kendrick, 1990) which may eventually settle on seed vegetables upon exposure. Mohammed *et al*., (2004) found eight different fungi, *Aspergillus niger*, *A. ochraceous*, *A. flavus*, *A. fumigatus*, *Penicilium citrinum*, *Curvolaria lunata* and *Sclerotium rolfsi* associated with tomato seed borne obtained from five different markets in Nigeria. *A. niger* and *A. flavus* had the highest rate of occurrence among the isolated fungi (Muhammed *et al*., 2004). The susceptibility of these vegetables to fungal pathogens is a source of worry because of the losses they cause including the loss of seed viability in some cases. Seed borne fungi pose serious problems to vegetable viz., pepper, okra and tomato. They cause yield loss of these crops by up to 50 - 60% (Quaicoe, 1991). A yield loss of 58 - 70% of tomato and pepper with 60 -70% severity has been reported in most tomato and pepper growing countries (Thakur and Chahal, 1970). Seeds infected by fungi are of poor quality reducing their acceptability and thus, the market value of the produce. As a result of various uses of vegetables and due to problems imposed by fungi which are seed borne, this research work is aimed to carry out isolation and (%) occurrence of seed borne fungi associated with pepper, (*Capsicum annum* L.), tomato (*Lycopersicom esculentum* Mill) and okra (*Abelmoschus esculentus* L.Moench) seeds collected from different Local Government Areas of Niger State.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted in the laboratory of the Department of Crop Production, Faculty of Agriculture, IBB University, Lapai, Niger State. However, collection of samples was done from six (6) Local Government Areas of Niger State. This lies at longitude 90°-02N and Latitude 6°-35E of the equator. The area is located in vegetative zone of guinea savannah middle belt of Nigeria. It has an average temperature of 23 - 34.4°C, minimum rainfall of 107.3 mm. The soil is literate or ferruginou (Geographical reformist, 2010).

Preparation of PDA Medium

Potato Dextrose Agar (PDA) was prepared in the laboratory, Department of Crop production, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai. For preparation of 1000 ml of PDA medium; 200 g peeled and sliced potato was cooked in a pan containing 500 ml of distilled water then filtered through several layers of muslin cloth and its volume was made to one litre after adding 500 ml of distilled water having dextrose-20 g, Agar agar-20 g. The PDA medium was gently poured into 250ml conical flasks and plugged with cotton wool and sterilized in an autoclave at 15lbs/inch^2 for 20 minutes.

Experimental design

The seed samples were collected from six (6) Local Government Areas of Niger State. Six samples were collected from each Local Government Area. A total of thirty six (36) samples were collected. For tomato and pepper 25 seeds per Petri-plate were placed, while, for okra 9 seeds were placed and each treatment was replicated four times.

Potato Dextrose Agar (PDA) medium and Standard Blotter Papers were used for the isolation of seed borne fungi. For PDA medium, before the placement of seeds on PDA medium, 20 ml of PDA medium was poured into each sterilized Petri plates and after solidification of the medium seeds were placed with the help of sterilized forceps under aseptic condition. On the seventh day of the incubation period, observations on the type of fungal growth were observed when slides of growing fungal mycelia and their fruiting structures were stained with lacto phenol and cotton blue and viewed under stereo microscope. Identification of fungi was done using morphological and microscopic characteristics viz., spore size, shape, colour and their arrangement on the conidiophores and morphology of the mycelium (Khan, 1992; Mathur and Kongsdal, 2003; Habib *et al*., 2011).

For Standard Blotter Papers, the pieces of blotters of the size of Petri plate were cut and placed in Petri plates and wet with sterilized distilled water. The excess water was drained off and seeds were placed in each sterilized Petri plate. The incubation was done for seven days at 28±1^{0}C and identification of the isolates (characteristics viz., spore size, shape, colour and their arrangement on the conidiophores and morphology of the mycelium) were carried out after staining with lacto phenol and cotton blue and viewed under stereo microscope at X40 magnification (Neergard 1988; Mew and Misra, 1994; Habib *et al*., 2011).

The % frequency occurrence of seed borne fungi was calculated by following formula:

$$\% \text{ frequency occurrence of seed borne fungi} = \frac{\text{Number of seeds infected with fungi} \times 100}{\text{Total Number of seeds}}$$

Isolation of Fungi from Unsterilized Seeds on PDA Medium

Seeds were rinsed in sterile distilled water three times. 20ml of sterilized PDA medium was poured into Petri plates and the seeds were placed according to their size (e.g. pepper and tomato; 100 seeds were replicated in four Petri plates i.e. 25 seeds per Petri plates; 16 in the outer circle, 8 in the inner and 1 in the centre while 36 okra seeds were replicated in four Petri plates e.g.9 seeds per Petri plates i.e. 5 in the outer circle, 3 in the inner and 1 in the centre. The observations on the associated fungi were recorded on the seventh day of incubation with the help of microscope. (Khan, 1992; Mathur and Kongsdal, 2003; Habib *et al*., 2011)

Isolation of Fungi from Sterilized Seeds on PDA Medium

The seeds were surface sterilized for at least 30 seconds in a 1.0% solution of sodium hypochlorite and rinsed 3 times in distilled water to remove surface fungi. Potato Dextrose Agar medium containing streptomycin antibiotics was used. The replication, incubation and identifications were the same with unsterilized seeds on PDA medium (ISTA, 2001; Mathur and Kongsdal, 2003).

Isolation of Fungi from Unsterilized Seeds on Standard Blotter Papers

The seeds were rinsed in distilled water three times. The seeds were then placed on standard blotter papers in the Petri plates. Tomato and chilli pepper were placed 25 seeds and okra seeds 9 seeds per Petri plates with the help of sterilized forceps under aseptic conditions in the incubation chamber. The seeds were place according to size of seeds (e.g. pepper and tomato; 25 seeds; 16 in the outer circle, 8 in the inner and 1 in the centre); while okra seeds were placed 9 seeds per Petri plate; (e.g. 5 in the outer circle, 3 in the inner and 1 in the centre so as to allow equal distance between seeds. Fungi were observed and identified on the seventh day based on morphological and microscopic characteristics viz., spore size, shape, colour and their arrangement on the conidiophores and morphology of the mycelium (ISTA, 2001; Mathur and Kongsdal, 2003; Malone and Muskette, 1964).

Isolation of Fungi from Sterilized Seeds on Standard Blotter Papers

The seeds were surface sterilized in sodium hypochlorite solution for 30 seconds to remove surface fungi and rinsed in distilled water three times. The

replication, incubation and identifications were the same with unsterilized seeds on standard blotter papers mentioned above.

RESULTS

Isolation of seed borne fungi from tomato, pepper and okra on PDA medium (Unsterilized Seed Method)

Observations on isolation of seed borne fungi from unsterilized seed method on tomato, pepper and okra from selected Local Government Areas of Niger State are shown in Table 1. The observation showed that almost all the selected vegetable seeds were infected to various degrees of different fungi. A total of 16 species of fungi viz., *Aspergillus niger, A. fumigates, A. flavus, Penicillium spinulosum, P. italium, P. repens, P. notatum, Mucor racemosus, M. hiemalis, M. mucedo, Verticillum. tenerum, V. cinnabarinum, V. albo-atrum, Alternaria solani, A. brassicae and A. arborescens.* The results clearly indicated that the seeds collected from different local government areas viz., Lapai, Paiko, Mokwa, Suleja, Kontagora and Borgu were contaminated by propagules of various fungi. *Aspergillus* spp. had the highest incidences; it appeared on almost all the seed sample collected from six (6) local governments areas of Niger State (Table 1), followed by *Mucor* spp. appeared on some of the seed samples, *Penicillium* spp. also appeared in number of seeds samples, while *Aternaria* spp. and *Verticillium* spp. appeared least in (Table 1). Borgu local government had the highest incidences of seed borne fungi. (Table 1) A total of five (5) genera namely *Aspergillus* spp., *Mucor* spp., *Penicillium* spp., *Alternaria* spp., and *Verticillium* spp., were recorded in these Local Government Areas. Mokwa had the least incidences of seed borne fungi (Table 1). Only three genera namely *Aspergillus* spp., *Mucor* spp., and *Penicillium* spp., were recorded from this Local Government Area.

Isolation of seed borne fungi from tomato, pepper and okra on PDA medium (Sterilized Seed Method)

The results in Table 2 show the observations of seed borne fungi from sterilized seeds of vegetables on PDA medium from selected Local Government Areas of Niger State. The observation on isolation of seed borne fungi isolated on PDA medium by surface-sterilized seeds method of tomato, pepper and okra, are presented on Table (2). There were eight (8) species of fungi appeared on surface-sterilized seeds on PDA medium of tomato, pepper and okra, these species belongs to three (3) genera namely *Aspergillus* spp., *Mucor* spp., and *Penicillium* spp. *Aspergillus* had the highest incidences in Lapai Local Government (Table 2), followed by *Mucor* spp., and *Penicillium* spp. appeared occasionally.

Isolation of seed borne fungi from tomato, pepper and okra on Standard Blotter Papers (Unsterilized Seed Method)

Observations were made on isolation of seed borne fungi from the unsterilized seeds on Standard Blotter Papers from different selected Local Government Areas of Niger State are presented in (Table 3). The fungal species and genera were isolated from the surface unsterilized seeds of tomato, pepper and okra seeds. The predominant fungal species encountered were *A. niger, A. fumigates, A. flavus, P. repens, M. mucedo, A. arborescens, A. solani, V. tenerum, V. cinnabarium, M. racemosus, M. hiemalis, P. italicum, P. natatum and V. albo-atrum.* Almost all the seeds collected were contaminated with various types of seed borne fungi. Borgu local government area had highest incidences of seed borne fungi isolated from surface unsterilized seeds on Standard Blotter Papers followed by Lapai Local Government Area, whereas, Mokwa L.G.A. had least incidence with only two genera viz., *Aspergillus* and *Mucor* species.

Isolation of seed borne fungi from tomato, pepper and okra on Standard Blotter Papers (Sterilized Seed Method)

Data on isolation of seed borne fungi from surface sterilized seeds of tomato, pepper and okra on Standard Blotter Papers from different Local Government Areas of Niger State are presented in Table 4. It is observed from Table 4, that six (6) species of fungi were isolated from sterilized seeds on Standard blotter Papers from two genera viz., *Aspergillus* spp., and *Mucor* spp. There were reduced incidences of fungi from sterilized seeds on Standard Blotter Papers. Some species of fungi that appeared in Table 3 were not appeared in Table 4.

Percentage occurrence of seed born fungi in tomato, pepper and okra seeds collected.

The observations in (%) occurrence of seed borne fungi in tomato, pepper and okra seeds collected from different Local Government Areas of Niger State are presented in Table 5. The results showed that Borgu Local Government Area of Niger State had the highest incidences of fungi, tomato had 98.00%, followed by okra 94.25% and pepper 90.75% from surface unsterilized seeds on PDA medium, whereas on surface sterilized seed, incidences of seed borne fungi had drastically reduced, tomato had 64.25%, okra 60.75% and pepper 56.00%. Followed by Suleja that had 87.75% from tomato, 86.25% from pepper and 80.25% from okra on unsterilized seeds on PDA medium, whereas on surface sterilized seed method, pepper had 58.75%, tomato 55.75% and okra had 48.25%. The percentages of occurrence were inversely related between the surface sterilized and unsterilized on PDA medium. Paiko Local Government Area had higher incidences of fungi followed by Suleja Local Government Area which recorded 76.00% from tomato, 72.25% from okra and 70.25% from pepper,

on unsterilized seeds while 47.74% from tomato, 44.00% from pepper and 35.25% from okra. Kontagora had 68.00% from tomato, 61.75% from pepper and 59.25% from okra on PDA medium while on surface sterilized seeds the percentage of occurrence reduced, 42.25% from tomato, 33.75% from okra and 31.00% from pepper were recorded as the percentage occurrence of fungi on seeds. Lapai had 56.75% of fungi occurrence from tomato, 48.00% from pepper and 46.25% from okra on PDA medium while on unsterilized seeds on PDA medium; the following were recorded 32.00% from tomato, 29.25% from pepper and 24.75% from okra on PDA medium. Mokwa had the least incidences of fungi as the least percentage occurrence in the area, okra had 42.74%, pepper had 40.25% and tomato had 36.00% on unsterilized seed method on PDA medium, while surface sterilized seeds also recorded reduced percentage occurrence in the local government area, tomato had 28.25%, okra had 25.25% and pepper 23.00% on PDA medium.

The observations on percentage occurrence of seed borne fungi on tomato, pepper and okra on Standard Blotter Papers revealed that Borgu Local Government Area had the highest incidences of fungi. It was observed that tomato had 72.25%, 68.75% from okra, and 65.75% from pepper on Standard Blotter Papers on unsterilized seeds while surface sterilized seeds recorded, tomato 49.25%, 41.75% from okra and 40.00% from pepper seeds, followed by Suleja that had 70.25% from tomato, 60.25% from pepper and 63.75% from okra seeds on unsterilized seed on blotter papers while on blotter papers, 46.00% from tomato, 42.25% from pepper and 39.75% from okra seeds on surface-sterilized seeds. Paiko had the significant percentage occurrence on seeds, 52.00% from tomato, 51.25% from okra, and 45.75% from pepper seeds on blotter papers on unsterilized seeds while sterilized seeds on blotter papers in Paiko recorded 36.75% from tomato seeds, 32.00% from pepper and 27.25% from okra seeds. Kontagora had 50.25% from tomato, 40.25% from okra and 39.75% from pepper from unsterilized seeds on blotter papers while, unsterilized seeds on blotter papers had 35.25% from tomato, 24.00% from pepper and 22.75% from okra. Lapai had reduced incidences on blotter papers, 40.25% from tomato, 39.00% from pepper and 37.75% from okra seeds from blotter papers on unsterilized seeds, in sterilized seeds pepper had 19.25%, okra 18.25% while tomato had 17.00%. Mokwa had the least incidences of fungi among the six (6) selected Local Government Areas of Niger State where 31.75% was recorded from pepper seeds, 28.25% from okra seeds and 24.75% from tomato seeds from blotter papers on unsterilized seeds while, sterilized recorded, seeds from blotter papers were recorded, pepper had 21.75% followed by okra with 16.25% and tomato had 14.25%. The percentage occurrence was highly varied between sterilized and unsterilized seeds

DISCUSSION

This study revealed the presence of sixteen (16) fungal species on tomato, pepper and okra seeds collected from different Local Government Areas of Niger State, Nigeria. These fungal species belongs to five genera. Most frequent fungal genera on unsterilized seeds were *Aspergillus* spp. *Mucor* spp. and *Penicillium* spp. This is similar to the findings of Mittal (1981) who reported that more pathogenic fungi or micro-organisms on the seeds in the unsterilized seeds. This might be due to higher number of fungi present on unsterilized seeds. It is noted that some of the fungi isolated both as surface contaminants and internally seed borne are known to cause serious field diseases of vegetables. In sterilized seeds on PDA medium, the isolation of seed borne fungi had reduced from five genera to three genera. This agrees with the reports of Mishra and Prakash (1975) that the use of 2% $NaOCl_2$ as seed disinfectant help appreciably in minimizing the incidence of superficial and fast growth as well as common seed borne fungi like *Aspergillus* spp., *Cladosporium* spp., *Rhizopus* spp., *Stemonitis irregularis* similar finding have been reported by several workers in the past (Arinze, 1986; Oladiran and Iwu, 1993; Neegaard *et al.*, 1970; Khan *et al.*, 1988; Dawar, 1994). Higher numbers of fungi were isolated in agar method than standard blotter method, and this may be due high nutrient availability in PDA medium than Standard Blotter Papers. Agar method was found most suitable for isolation of *Aspergillus* spp., *Curvularia* spp., and *Fusarium* spp. This is in conformity with the findings of Khan *et al.* (1988) who preferred the use of agar plate method over the blotter method for isolation of *Aspergillus* spp., *Curvolaria* spp., and *Fusarium* spp., from disinfected seeds. The use of Blotter method also yielded the growth of fungal species from the study area. Such similar results have been observed from the detection of seed borne fungi in rice (Khan *et al.*, 1988) and sunflower (Dawar, 1994). Similar case was reported by Begum and Momin (2000), they reported that Blotter method was found useful for detection of most of infectious fungi of cucurbits.

Khan *et al.* (1988) reported that agar plate method is more suitable for deeply seated seed borne fungi especially *Fusarium* spp. these fungal species causes series of diseases to vegetable and other food crops. The present work also agrees with the reports of Makelo (2010), *Penicillium digitatum, A. flavus,* and *A. niger* were isolated from pepper fruits and seeds and were demonstrably pathogenic on pepper seeds. Al-kassan and Monawar (2000) reported that some of the seed borne fungi are also known to cause seed rot, decrease seed germination and cause pre and post dumping off and seedling death. Several fungal species are found associated with vegetables and

causes greater loss to the fruits and seeds. This is in conformity with the findings of Muhammed *et al*. (2004) who reported eight different fungi, *A. niger A. ochraceous, A. flavus, A. fumigates, P. citrinum, Curvolaria lunata* and *Screrotum rolfsi* associated with rotten tomato fruits. The susceptibility of these vegetables to fungal species is a source of worry because of the losses they cause, including loss of seed viability in some cases. In the present study, seed borne associated with vegetable seeds of pepper, tomato and okra from different Local Government Areas of Niger State, Nigeria were examined.

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Table 1: Isolation of seed borne fungi from tomato, pepper and okra on PDA medium (Unsterilized Seed Method) from different Local Government Areas of Niger State

S/N	Location	Seed	Fungi isolated
1		Tomato	*Aspergillus niger, A. fumigatus, A. flavus, Penicillium notatum, P. repens, Mucor mucedo*
	Lapai	Pepper	*M. rocemosus, A. niger, A fumigatus, P. notatum*
		Okra	*M. mucedo, A. niger, A. fumigates, A. flavus, Alternaria solani*,
2		Tomato	*A. flavus, A niger M. mucedo*
	Mokwa	Pepper	*A. niger, A. fumigates, P. notatum*
		Okra	*M. rocemosus, A. niger, A. fumigates*
3		Tomato	*M. hiemalis, M. mucedo, A. fumigates, A. niger, A. flavus*
	Suleja	Pepper	*A. niger, A. fumigatus, P. italicum*
		Okra	*A. fumigatus, P. spinulosum, A. niger*
4		Tomato	*M. mucedo, V. notatus, A. niger, A. fumigates, A. solani*
	Paiko	Pepper	*A. Fumigates, M. racemosus, A. niger*
		Okra	*Verticillium cinnabarium, P. repens, A. fumigatus*,
5		Tomato	*P. notatum, A. niger, A. fumigatus*
	Kontagora	Pepper	*A. niger A. A flavus, P. repens*
		Okra	*A. flavus, M. mucedo, A. fumigatus, P. digitatum*
6		Tomato	*A. fumigates, A. solani, A. niger, A. flavus, M. hiemalis*
	Borgu (New Bussa)	Pepper	*V. albo-atrum, M. racemosus, A. niger*,
		Okra	*M. mucedo, A. solani, A. niger, A. fumigates, P. italicum, P. repens, V. albo-atrum, A. arborescens*

Table 2. Isolation of seed borne fungi from tomato, pepper and okra on PDA medium (Sterilized Seed Method) from different Local Government Areas of Niger State

S/N	Location	Seed	Fungi isolated
1		Tomato	*Mucor mucedo*, A *niger*
	Lapai	Pepper	*Penicilium* repens, *A. fumigatus*,
		Okra	*A. flavus*,
2		Tomato	*M. mucedo*, *M. recemosus*
	Mokwa	Pepper	*M. hiemalis*,
		Okra	*M. mucedo*, *A. niger*
3		Tomato	*A. flavus*
	Suleja	Pepper	*M. racemosus, A. fumigates*
		Okra	*Mucor* spp, *A. niger*
4		Tomato	*M. mucedo, A. niger*
	Paiko	Pepper	*M. racemosus,*
		Okra	*M. mucedo A. fumigates*
5		Tomato	*M. mucedo*,
	Kontagora	Pepper	*M. mucedo*
		Okra	*M. racemosus, A. niger*
6		Tomato	*M. hiemalis, P. repens*
	Borgu (New Bussa)	Pepper	*M. mucedo*
		Okra	*M. mucedo*, *A. flavus*

Table 3. Isolation of seed borne fungi from tomato, pepper and okra on Standard Blotter Papers (Unsterilized Seed Method) from different Local Government Areas of Niger State

S/N	Location	Seed	Fungi isolated
1	Lapai	Tomato	*Aspergillus niger, A. fumigates, Penicillium repens, A. flavus*
		Pepper	*Mucor mucedo, A niger, Alternaria arborescens*
		Okra	*P. repens, A .niger, M. mucedo*
2	Mokwa	Tomato	*M.racemosus, A. niger, A. fumigates*
		Pepper	*M. mucedo, A. fumigates*
		Okra	*A .niger, M. racemosus*
3	Suleja	Tomato	*P. repens, M. mucedo, A. niger*
		Pepper	*A .niger, A. fumigates*
		Okra	*M. hiemalis, A. niger, V. tenerum*
4	Paiko	Tomato	*M. mucedo, A. niger, A. fumigates*
		Pepper	*P. notatum, A. niger, A. flavus*
		Okra	*A. niger, A. fumigates, A. solani*
5	Kontagora	Tomato	*V. cinnabarinum, A. niger, M. mucedo*
		Pepper	*A .niger, A. fumigates, M. racemosus*
		Okra	*P. repens, A. flavus, A. niger*
6	Borgu (New bussa)	Tomato	*A. niger, P. italicum, A. fumigates, A. solani*
		Pepper	*A. fumigatus, M. mucedo, A. niger, A. fumigatus*
		Okra	*A. fumigates, A. niger, V. tenerum*

Table 4. Isolation of seed borne fungi from tomato, pepper and okra on Standard Blotter Papers (Sterilized Seed Method) from different Local Government Areas of Niger State

S/N	Location	Seed	Fungi isolated
1		Tomato	*Mucor mucedo, M. racemosus*
	Lapai	Pepper	*M. mucedo, Aspergillus niger*
		Okra	*A. flavus, M. hiemalis*
2		Tomato	*A. niger, M. mucedo*
	Mokwa	Pepper	*M. hiemalis, M. racemosus*
		Okra	*A.flavus*
3		Tomato	*M. racemosus*
	Suleja	Pepper	*A. flavus, M. mucedo*
		Okra	*M. mucedo*
4		Tomato	*A .niger, M. hiemalis*
	Paiko	Pepper	*M. mucedo*
		Okra	*M. racemosus, M. mucedo*
5		Tomato	*A .niger, M. mucedo*
	Kontagora	Pepper	*M. hiemalis, M. racemosus*
		Okra	*M. mucedo, A .fumigatus*
6		Tomato	*M. racemosus, M. mucedo*
	Borgu (New Bussa)	Pepper	*A .niger, M. racemosus*
		Okra	*M. mucedo, A .niger*

Table 5. Percentage occurrence of seed born fungi in tomato, pepper and okra seeds collected from different Local Government Areas of Niger State

			% occurrence (on PDA medium)		% occurrence (on SBP)	
S/N	Location	Seed	US	S	US	S
1		Tomato	56.75	32.00	40.25	17.00
	Lapai	Pepper	48.00	29.25	39.00	19.25
		Okra	46.25	24.75	37.75	18.25
2		Tomato	36.00	28.25	24.75	14.25
	Mokwa	Pepper	40.25	23.00	31.75	21.75
		Okra	42.75	25.25	28.25	16.25
3		Tomato	87.75	55.75	70.25	46.00
	Suleja	Pepper	86.25	58.75	60.25	42.25
		Okra	80.25	48.25	63.75	39.75
4		Tomato	76.00	47.75	52.00	36.75
	Paiko	Pepper	70.25	44.00	45.75	32.00
		Okra	72.25	35.25	51.25	27.25
5		Tomato	68.00	42.25	50.25	35.25
	Kontagora	Pepper	61.75	31.00	39.75	24.00
		Okra	59.25	33.75	40.25	22.75
6	Borgu	Tomato	94.25	60.75	72.25	49.50
	(New Bussa)	Pepper	90.75	56.00	65.75	40.00
		Okra	98.00	64.25	68.75	41.75

* US = Unsterilized * S = Sterilized