Fungal organisms associated with post-harvest rot of frafra potatoes [*Solenostemon rotundifolius* (Poir.)] In Bongo-Soe, Upper East Region, Ghana

Aims: The study aims to identifying the microorganisms associated with post-harvest rot of frafra potatoes in Bongo-soe, Upper east region of Ghana

Place and Duration of Study: Department of Horticulture and the Pathology laboratory of the Faculty of Agriculture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. The *Solenostemon rotundifolius* tubers were stored at the Horticulture Department laboratory whiles rot identification was carried out at the Pathology laboratory of the Faculty of Agriculture. The Tubers were stored from 2nd November, 2012 to 22nd March 2013.

Methodology: Four hundred (400) tubers of black cultivar and four hundred (400) tubers of brown cultivar of *Solenostemon rotundifolius* tubers showing visible signs of rot during the storage were collected. Pieces of diseased tissues from the margin of the necrotic collected and immersed in 10 % commercial bleach solution for sterilization, for one minute. These were then blotted dry and plated on Potato Dextrose Agar (PDA. The plates were sealed with a cellotape until growth occurred.

Results: the microorganisms identified to be responsible for causing rot in *Solenostemon rotundifolius* tubers were six in number. *Colletotrichum gloeosporioides* was identified to be responsible for 30.76 % of rots observed, followed by *Aspergillus niger*, 23.07 %, *Curvularia lunata*, 19.23 %, *Aspergillus flavus*, 11.54 %, *Trichoderma sp* and *Penicillium sp* both recorded 7.70 % of rots observed. The percentage incidence of *Aspergillus niger* (15.38%), *Curvularia lunata* (11.54%) and *Aspergillus flavus* (7.69%) was higher in the black cultivar as compared with the brown cultivar which had percentage incidence of 7.69%, 7.69% and 3.85% respectively. Also, the percentage incidence of *Colletotrichum gloeosporioides* (15.38%) and *Penicillium sp* (3.85%) was the same in both the black and brown cultivars of *Solenostemon rotundifolius* tubers used in this study.

Conclusion: The activities of the damaging microorganisms can be reduced by controlling mechanical injury during harvesting, transportation and storage of *Solenostemon rotundifolius* tubers should be prevented or reduced because they pave way for tuber infection by the rot causing microorganisms.

1.0 Introduction

Solenostemon rotundifolius (Frafra potato) belongs to the family Lamiaceae (Labiatae) (Tindall, 1983). Frafra potatoes are herbaceous perennials normally cultivated as annuals

(National Research Council, NRC, 2006). In Ghana, the crop is mainly cultivated in the guinea and Sudan savannah agro-ecological zones (Opoku-Agyeman *et al*., 2004). The areas of cultivation mainly cover the Upper East and Upper West regions of Ghana. However, the crop can also be cultivated in the moist semi deciduous forest ecology of Ghana (Opoku-Agyeman *et al.,* 2004). *Solenostemon rotundifolius* is an important food security crop (Burkill, 1995 and National Research Council, 2006). Apart from cultivation of frafra potatoes for consumption, the crop also has medicinal, industrial and sociocultural importance in areas of its cultivation in Ghana (Apabol 1997 and Tetteh *et al.* 1997, Umar, 2016).

In spite of its importance, frafra potato cultivation appears to be declining in Ghana due to numerous problems encountered by farmers during cultivation. These include post-harvest loss during storage (Tindal, 1983, Vowotor et al, 2012) which contributes to the immensely to spoilage (rotting) of tubers in storage (Tetteh *et al.* 1997, Sharma, 2016).

Postharvest spoilage (rot) is a major contributor to losses of all root and tuber crops via microbial infestation of healthy tubers which reduces the table quality of such tubers and renders them unappealing to consumers (Amusa, 1999, Anjorin et al, 2014).

Roots and tubers have been subjected to several diseases by several post-harvest rot causing organisms including viruses, fungi, bacteria, nematodes etc. For instance in yam (*Dioscoreae Sp*), the microorganisms commonly associated with storage rots include: *Sclerotium rolfsii*, *Colletotrichum gloeosporioides*, *Aspergillus* spp, *Botryoidplodia theobromea*, *Curvularia verruculosa*, *Rhizoctonia solani*, *Penicillium* spp and *Fusarium moniliforme* (Nwankiti and Okpala, 1981; Green, 1994). Also in Sweet potatoes (*Ipomoea batatas*), pathogens commonly associated with storage rots include: *Ceratocystis fimbriata* (a fungus that causes Black rot), *Fusarium* (a fungus that causes Fusarium surface rot and Fusarium root rot), *Rhizopus*

stolonifer (a fungus that causes Rhizopus soft), *Diplodia gossypina* (a fungus that causes Java black rot), *Erwinia chrysanthemi* (a bacteria that causes Bacterial soft rot, also known as bacterial stem and root rot), *Monilochaetes infuscans* (a fungus that causes scurf, also known as soil-stain), *Macrophomina phaseoli* (a fungus that causes Charcoal rot) (Sikora *et al.*,1995). However, for *Solenostemon rotundifolius*, no published research work has been cited on the microorganisms associated with post-harvest rot until recently. Mohammed *et al*., (2013) indicates that the following microorganisms are associated with post-harvest rot of *Solenostemon rotundifolius* in Nigeria; *Aspergillus niger*, *Fusarium oxysporum*, *Penicillium expansum* and *Rhizopus stolonifer*. However, no research work has been cited on the microorganisms associated with post-harvest rot of *Solenostemon rotundifolius* in Ghana. This research work therefore has the overall objective of identifying the microorganisms associated with post-harvest rot of frafra potatoes in Bongo-soe, Upper east region of Ghana.

2.0 Materials and methods

2.1 Geographical location of the experimental site

The research work was carried out at the laboratory of the Department of Horticulture and the Pathology laboratory of the Faculty of Agriculture, Kwame Nkrumah University of science and Technology (KNUST), Kumasi, Ghana.

The *Solenostemon rotundifolius* tubers were stored at the Horticulture Department laboratory whiles rot identification was carried out at the Pathology laboratory of the Faculty of Agriculture.

2.2 Procurement of Frafra potato (*Solenostemon rotundifolius*) tubers and Preparation

The black and brown cultivars of frafra potato tubers used for this research were all obtained from a single farm in Bongo-soe, in the Bongo district of the Upper East region of Ghana.

The farm was monitored from planting to harvest, fresh tubers were subsequently obtained on the day of harvestfor experimentations. A total of eight hundred samples of frafra potato tubers were used for the studies. This was made up of four hundred black cultivars and four hundred brown cultivars of wounded and non-wounded tubers, the samples were visually inspected for any sign of rot and defective samples were discarded. The tubers were stored in sixteen medium sized plastic bowls which contained fifty tubers each.

2.3 Identification of rot pathogens

The Tubers were stored for 141 days, from 2nd November, 2012 to 22nd March 2013. Tubers showing visible signs of rot were taken to the Pathology laboratory of the Faculty of Agriculture for identification of the possible microorganisms responsible for the rot. This was done fortnightly.

The procedure involved taking pieces of diseased tissues (2-5 mm square) from the margin of the necrotic lesion using a sterile scapel blade and surface sterilizing of the necrotic tissue segments done by immersing the tissue segments in 10% commercial bleach solution in a beaker for one minute. Tissue segments were taken out of the sterilant solution in intervals of 10 seconds and blotted dry with a clean paper towel. This ensured that at least some of the segments were exposed to the sterilant for the appropriate period of time. The surface sterilized tissue segments were then plated on Potato Dextrose Agar (PDA) medium, using a pair of forceps which was flamed sterilized periodically. The plates were sealed with a sellotape to prevent desiccation and contamination and incubated at room temperature until growth occurred. The plates were then observed daily for fungal growth from the tissues. The characteristics of the spore and mycelium were studied using a compound microscope. The characteristics observed were used in identifying the rot organisms according to standards described by Mathur and Kongsdal (2003) and Barnett and Hunter (1972).

3.0 Results and discussions

Five genera of microorganisms were identified to be associated with post-harvest rot of stored frafra potato tubers. These are: *Curvularia* sp., *Colletotrichum* sp., *Aspergillus* sp., *Penicillium* sp. and *Trichoderma* sp.

The microorganisms identified to be responsible for causing Post-harvest rot in *Solenostemon rotundifolius* tubers were six in number. *Colletotrichum gloeosporioides* was responsible for 30.76 % of rots observed, *Aspergillus niger*, 23.07 %, *Curvularia lunata*, 19.23 %, *Aspergillus flavus*, 11.54 %, *Trichoderma* sp. and *Penicillium* sp. both recorded 7.70 % of rots observed.

The percentage incidence of *Aspergillus niger* (15.38%), *Curvularia lunata* (11.54%) and *Aspergillus flavus* (7.69%) was higher in the black cultivar as compared with the brown cultivar which had percentage incidence of 7.69, 7.69 and 3.85% respectively. Also, the percentage incidence of *Colletotrichum gloeosporioides* (15.38%) and *Penicillium sp* (3.85%) was the same in both the black and brown cultivars of *Solenostemon rotundifolius* tubers used in this study. *Trichoderma* sp.caused rot in only tubers of the brown cultivar with percentage incidence of 7.07%. In all, tubers of the black cultivar had more incidence of rot causing microorganisms (53.84%) compared with tubers of the brown cultivar which had a total incidence of 46.16%.

The identification of *Aspergillus niger and Penicillium* sp.. confirmed the observations made by Mohammed *et al*. (2013). This is the first time *Colletotrichum gloeosporioides, Curvularia lunata, Aspergillus flavus,* and *Trichoderma* sp. have been found to cause post-harvest rot in *Solenostemon rotundifolius* tubers. *Curvularia lunata, Colletotrichum gloeosporioides, Aspergillus niger, Aspergillus flavus, Penicillium* sp. and *Trichoderma* sp.have been found to be associated with rot in other roots and tuber crops such as Yam (Nwankiti and Okpala, 1981; Green, 1994), sweet potato (Rees *et al.*, 2003), cassava

(Messiga *et al*. 2004). These microorganisms identified are wound pathogens that infect mechanically injured tubers and have been found to infect tubers in the field and later manifest in storage (Rees *et al*., 2003, Okigbo *et al*., 2010). These microorganisms can also infect tubers through diseased foliage, mother tubers or roots (Nmeka and Okigbo 2005).

The skin of *Solenostemon rotundifolius* tubers is easily damaged (Mohammed *et al.,* 2013) and farmers make matters worse with poor practices that encourage mechanical injury on tubers during harvesting, transportation and even storage. This therefore explains the presence of these microorganisms in the *Solenostemon rotundifolius* (frafra potatoes) tubers used in this study.

4.0 Conclusion

The findings of this study have shown that *Colletotrichum gloeosporioides, Aspergillus flavus, Aspergillus niger, Curvularia lunata, Penicillium* sp.and *Trichoderma* sp. are responsible for the post-harvest rot of *Solenostemon rotundifolius* tubers in Bongo-soe, Upper East Region of Ghana.

5.0 Recommendation

Mechanical injury during harvesting, transportation and storage of *Solenostemon rotundifolius* tubers should be prevented or reduced since mechanical injuries can pave the way for tuber infection by the rot causing microorganisms identified in this study.

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