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EFFECT OF PLANT POWDERS ON THE DEVELOPMENT OF TOMATO FRUIT ROT FUNGI (*Solanum lycopersicum L.var.* Rio Grande)

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ABSTRACT

The aim of the study was to evaluate the activity of Carica papaya, Cupressus lusitanica, Chromolaena odorata and Mirabilis jalapa powders against Geotrichum candidum, Aspergillus niger, Phoma sp, Alternaria alternata, Aspergillus fumigatus, Trichoderma harzianum and Aspergillus flavus associated with tomato rots, while limiting the use of chemical products. To achieve this, powders of these plants harvested in the town of Dschang were applied against the various fungal species tested at doses of 1g, 2g and 3g respectively. The experimental set-up was completely randomised, with three replicates. The antifungal tests showed that all the plant powders relatively inhibited the growth of the different fungal species tested compared with the negative control. However, the Carica papaya and Chromoleana odorata powders were the most effective, completely inhibiting the growth of Geotrichum candidum, Aspergillus niger, Phoma sp, Aspergillus fumigatus, Trichoderma harzianum and Aspergillus flavus from 2g upwards. These results suggest a possible use of Carica papaya and Chromolaena odorata powders as alternatives to chemicals in the control of fungi associated with tomato fruit rots.

Keywords: Plant Powders, Rot Fungi, Tomatoes.

1. INTRODUCTION

The tomato (*Solanum lycopersicum L*. var. Rio Grande) is one of the most widely consumed fruits by millions of people around the world (Afroz *et al*., 2008). Trade in tomatoes represents more than 17% of world trade in fresh fruit and vegetables, with a value of more than 8.5 billion dollars (USAID, 2006). In Cameroon, tomato production has been increasing over the years, from 14,000 tonnes in 2005 (FAO, 2006) to 880,000 tonnes in 2012 (FAOSTAT, 2014), an increase of 866,000 tonnes, with the West region being the main production area (Rock, 2015). Consumers' enthusiasm for this fruit is justified by its high vitamin and antioxidant content (Abushita *et al*., 2000; Bramley, 2002; Fanasca *et al*., 2006). Regular consumption of tomatoes reduces the incidence of cardiovascular disease, cancer and degenerative diseases associated with old age (Maséréjian *et al*., 2006; Wojcik *et al*., 2010). Despite the importance of tomatoes and their many virtues, these fruits face a number of constraints after harvest, including fungal rots that can cause losses of up to 60% (Kutama *et al*., 2007). Fungicides such as Mancozeb, Mylone, Prochloraz, Imazalil or Benomyl are most often used to protect these fruits from rotting fungi.

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However, these chemical products are becoming increasingly limited due to their high cost, the unavailability of some of these products on the local market and the induction of fungicide resistance or ineffectiveness depending on the production area and time of year (Alavanja *et al.*, 2004; Andreotti *et al.*, 2009; Swami and Alane, 2013). In addition, these fungicide treatments pose problems of residues in fruit and environmental pollution (Ozbay *et al.*, 2004; Anil *et al.*, 2015). The perception of these risks is now prompting a reorientation of plant product protection strategies, which are in line with current requirements in terms of fruit quality and the development of a sustainable and profitable fruit sector. Faced with the inconvenience of chemical pest control, it is necessary to develop new alternative pest control methods, such as the use of plant powders. Indeed, the evaluation of plant powders as bio-fungicides has had inhibiting effects on the development of many fungi isolated from tomato fruit. Akinsoye & Oladunmoye (2000) showed that Mirabilis jalapa powders inhibited the mycelial growth of certain fungi associated with tomato fruit rot. Similarly, *Allium sativum* and *Zinginber officinale* powders inhibited the development of tomato fruit rot fungi (Chuku *et al.*, 2010). Despite these previous studies on the fungi associated with tomato fruit rots in many countries using plant powders, very few studies have been carried out on those associated with these rots in Cameroon. The aim of the present study is to evaluate the antifungal activity of four plant powders (*Carica papaya, Chromolaena odorata, Cupressus lusitanica* and *Mirabilis jalapa*) on the development of fungi associated with tomato fruit rots, with a view to reducing post-harvest rots.

2. MATERIALS AND METHODS

2.1. Tomatoes fruits

Rotten and apparently healthy tomato fruits (var. Rio Grande) were collected from different markets in 4 localities (Bagangté, Dschang, Foumbot and Mbouda) in the West Cameroon region during the months of May to July 2015. The fruit collected was placed in labelled plastic bags and transported to the phytopathology laboratory (PHYTOLAB) at the University of Dschang for further work.

2.2. Plants to be tested

The leaves of four plants (Table 1) were collected in the town of Dschang during April 2015 on the basis of their efficacy against certain fungi.

Table 1: Plants used

Common name	Scientific name	Family
Papayer	*Carica papaya*	*Caricaceae*
Cyprès	*Cupressus lusitanica* Mill	*Cupressaceae*
Belle de nuit	*Mirabilis jalapa* L	*Nyctaginaceae*
Herbe du Laos	*Chromolaena odorata*	*Asteraceae*

2.3. Isolation, purification and identification of fungi

Geotrichum candidum, Aspergillus niger, Phoma sp, Alternaria alternata, Aspergillus fumigatus, Trichoderma harzianum and Aspergillus flavus were isolated from rotten tomato fruits collected

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from various markets in localities in the West Cameroon region. Identification was carried out in the Phytopathology laboratory of the University of Dschang as described by Njimah (2016) and the pure cultures obtained were preserved in PDA culture medium at 4°C.

2.4. Preparation of plant powders

The leaves of the various plants harvested were dried separately in the shade for 2 weeks and ground finely in a mill until the powders were obtained (Djeugap *et al*., 2011).

2.5. Effect of plant powders on the growth of fungi

Ten apparently healthy tomato fruits were disinfected with 95% ethanol, then cut into three slices each. Each tomato slice was inoculated with a 6 mm diameter mycelial disc of a fungal species. Inoculation with the different fungal species was followed by deposition of plant powders at doses of 1g, 2g and 3g respectively. Fruit slices inoculated with inoculum only and those inoculated simultaneously with inoculum of the different pathogens and Mancozeb powder were used as negative and positive controls respectively. These tomato slices were placed in sterilised crystallizers and incubated at a temperature of 20 ± 2°C. After four days of incubation, observations were made on the growth (+) or non-growth (-) of the fungi. The experimental set-up was completely randomised, with three replicates.

3. RESULTS

The plant powders applied to the different fungal species relatively inhibited the growth of the fungi tested, depending on the doses used, compared with the negative controls. *Carica papaya* powders completely inhibited the growth of *Aspergillus fumigatus, Phoma sp, Phomopsis vexans* and *Trichoderma harzianum* at all doses. Similarly, *Aspergillus niger* and *Alternaria alternata* were completely inhibited at all doses by *Chromoleana odorata* powders. *Cupressus lusitanica* and *Mirabilis jalapa* powders inhibited the development of *Phoma sp* and *Aspergillus fumigatus* respectively at all doses (table 2). Of all the fungal species tested, *A. fumigatus* from Bagangté was totally inhibited (at all doses) by all four plant powders, while *Alternaria alternata* from Mbouda was not inhibited at any dose by *Cupressus lusitanica* powders**.**

Table 2: Rates of inhibition of fungal growth by plant powders

Plant powders	Dose (g)	Fungal species			
Mbouda					
		Alternaria alternata	*Aspergillus niger*	*Phoma sp*	*Trichoderma harzianum*
Carica papaya	**1g**	+	+	-	-
	2g	-	-	-	-
	3g	-	-	-	-
Cupressus lusitanica	**1g**	+++	-	-	+
	2g	+++	-	-	+
	3g	+++	-	-	+
Chromolaena odorata	**1g**	-	-	+	+
	2g	-	-	+	-
	3g	-	-	+	-
Mirabilis jalapa	**1g**	+++	-	+	+
	2g	-	-	-	-
	3g	-	-	-	-
T+((mancozeb)	**1g**	-	-	-	-
T-(no treatment)	**0g**	+++	+++	+++	+++
Dschang					
		Alternaria alternata	*Aspergillus niger*	*Phomopsis vexans*	*Geotrichum candidum*
Carica papaya	**1g**	+++	+	-	-
	2g	-	-	-	-
	3g	-	-	-	-
Cupressus lusitanica	**1g**	+++	-	+++	+
	2g	-	-	-	-
	3g	-	-	-	-
Chromoleana odorata	**1g**	-	-	-	+
	2g	-	-	-	-
	3g	-	-	-	-
Mirabilis jalapa	**1g**	+++	-	+	+++
	2g	+	-	-	+++
	3g	-	-	-	+
T+((mancozeb)	**1g**	-	-	-	-
T-(no treatment)	**0g**	+++	+++	+++	+++
Bagangté					
		Aspergillus fumigatus	*Phoma sp*	*Geotrichum candidum*	
Carica papaya	**1g**	-	-	-	
	2g	-	-	-	
	3g	-	-	-	

Cupressus lusitanica	**1g**	-	-	-
	2g	-	-	-
	3g	-	-	-
Chromoleana odorata	**1g**	-	+++	+++
	2g	-	-	-
	3g	-	-	-
Mirabilis jalapa	**1g**	-	-	+
	2g	-	-	-
	3g	-	-	-
T+ ((mancozeb)	**1g**	-	-	-
T-(no treatment)	**0g**	+++	+++	+++

Foumbot					
		Alternaria alternata	*Aspergillus flavus*	*A. niger*	*Trichoderma harzianum*
Carica papaya	**1g**	+++	+	+	-
	2g	-	-	-	-
	3g	-	-	-	-
Cupressus lusitanica	**1g**	+++	-	+	+++
	2g	-	-	-	-
	3g	-	-	-	-
Chromoleana odorata	**1g**	-	+++	-	+
	2g	-	-	-	-
	3g	-	-	-	-
Mirabilis jalapa	**1g**	+++	+	+	+
	2g	-	-	-	-
	3g	-	-	-	-
T+((mancozeb)	**1g**	-	-	-	-
T-(no treatment)	**0g**	+++	+++	+++	+++

- no fungal growth; +, less than 20% growth; +++ 100% growth T-: Negative control (no treatment) and T+: Positive control (mancozeb).

4. DISCUSSION

The antifungal tests showed that the different plant powders generally had a depressive effect on the growth of the different fungal species compared with the negative control. This inhibitory effect could be due to the fact that the plants used could contain compounds or inhibitory substances that would have influenced the growth of the fungal species tested. The work of Lopéz *et al* (2002), Ling *et a*l (2003), Pamo *et al* (2003) and Rahman *et al* (2009) has shown that certain plants contain compounds with antifungal properties (alkaloids, sterols, terpenoids, flavonoids, anthraquinone phenols, saponins or tannins). The rate of inhibition of the different fungal species varied depending on the plant and fungal species used. This variation is thought to be due to their different chemical composition. In fact, *A. fumigatus*, *Phoma sp*, *Phomopsis vexans* and *Trichoderma harzianum* were completely inhibited at all doses by *Carica papaya* powders. The total inhibition of these species by these plant powders could be due to the action of the phenolic compounds (alkaloids) present in papaya leaves, which would have had a detrimental effect on the growth of this fungal species. These results are similar to those of Amadioha (1998), Owolade and Osikanlu (1999) and Adejunmo *et a*l (2000) who reported the inhibitory effect of this plant against *Erysiphe cichoracearum*, *Collectrotrichum sp* and *Protomycopsis phaseoli*. Similarly, *Aspergillus niger* and *Alternaria alternata* were completely inhibited at all doses by Chromoleana odorata powders. The active ingredients (alphapinene, germacrene, betacaryophylene) present in the various organs of C. odorata are thought to have had a harmful effect on fungal growth. Chemical analysis of C. odorata leaves by Lin *et a*l (2003) and Noudogbessi (2008) showed that alphapinene and betacaryophylene were the main fungicidal components present. Extracts from this plant had also been shown to be effective against fungi associated with rotting of other fruits such as bananas (Kra *et al*., 2009). *Fusarium oxysporium* and *Phoma sp* were completely inhibited at all doses by *C. lusitanica* powders. These results obtained with *C. lusitanica* leaf powders are similar to those obtained by Keuete *et al*. (2015), who showed that these extracts inhibited the development of *Botryosphaera dothiorella*, *Collectrotrichum gloeosporioides* and *C. purpurea*, respectively. However, in the case of Mirabilis jalapa powders, the inhibition of fungal growth by these powders could be attributed to the isoflavone and dehydrorotenoid contained in the leaves, which inhibit fungal growth. Studies on the antifungal effect of *M. jalapa* leaves have shown that the leaves of this plant also contain compounds with antifungal properties (Basini, 2013). *A. fumigatus* from Bagangté was totally inhibited (at all doses) by all four plant powders compared to other species from the same locality. *Alternaria alternata* from Mbouda was not inhibited at any dose by *Cupressus lusitanica* powders. This difference could be explained by the greater sensitivity of *A. fumigatus* to these powders compared with *Alternaria alternata*. Further studies will be able to confirm this.

5. CONCLUSION

The study showed that all the plant powders had an inhibitory effect on the growth of the fungi tested. However, the *Carica papaya* and *Chromolaena odorata* powders at doses of 2g and above were the most effective, completely inhibiting the growth of almost all the fungal species tested. These powders could therefore provide an alternative means of controlling the fungi associated with tomato fruit rot. This preliminary study provides a basis for future trials with the extracts.

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Conflict of interest

Authors declare that, there is no conflict of interest.

REFERENCES

Abushita A. A., Daood H. G. & Biacs P. A., 2000. Changes in carotenoids and antioxidant vitamins in tomato as a function of varietal and technology factors. *Journal of Agricultural and Food Chemistry*, 48 (6): 2075-81.

Adebitan S.A., Haruna A.U., Gurama S.G., Safiva T. & Tijjani A., 2014. Effect of some selected plant extracts on *Aspergillus flavus,* a causal agent of fruit rot disease of tomato *(Solanum lycopersicum)* in Bauchi State. *International Journal of Biosciences*, 4 (3): 244-252.

Ademutwa J.A., Ijato J.Y., Oyemi S.D. & Ijadunola J.A., 2010. Allelopathic effect of leaf extract of *Azardirachta indica* and *Chromolaena odorata* against post-harvest and transit rot of tomato (*Lycopersicum esculentum* L). *Journal of American Science*, 6 (12): 1-5.

Afroz M., Ashrafuzzamani M., Ahmed M.N, Ali M.E., and Azim M.R. 2008. Integrated management of major fungal disease of tomato. *International Journal of Sustainable Crop Production,* 3(2):54-59.

Alavanja M.C.R., Dosemeci M., Samanic C., Lubin J., Lynch C.F. & Knott C.E., 2004. Pesticides and lung cancer risk in the Agricultural Health Study cohort. *Am J Epidemiol*., 160: 876-885.

Amadioha A.C & Obi V.I., 1998. Fungitoxic activity of extracts from *Azadirachta indica* and *Xylopia aethiopica* on *Collectotrichum lindenmuthianum* in cowpea. *Journal of Herbs, Spices and Medicinal Plants,* 6 (2):33-40.

Andreotti G., Beane-Freeman L., Hou L., Coble J. & Hoppin J.A., 2009. Agricultural pesticides use and pancreatic cancer risk in the Agricultural Health Study cohort. *Inernationalt Journal of Cancer,* 124: 2495-2500.

Anil K.R. & Raj K. H.G., 2015. *In vitro* antifungal activity of some plant extracts against *Fusarium oxysporum* isolated of *Lycopersicum solanum*. *Asian Journal of Plant Science and Research*, 5 (1): 22-27.

Barnett H.L. & Hunter B.B., 1972. Illustrated genera of imperfect fungi.3rd edition. *Burgess Publishing Company*, 1-200 p.

Basini J., Mohanalakshmi S. & Anitha K., 2013. Protective effect of *Mirabilis jalapa* leaves on anti-tubercular drugs induced hepatotoxicity. *Journal of Pharmaceutical and Clinical Researh,* 6 (3): 974-2441.

Bramley P.M., 2002. Regulation of carotenoid formation during tomato fruit repening and Development. *Journal of experimental Botany*, 53:2107-2113.

Cristescu S.M., Martinis D., Hekkert S.T.L., Parker D. H. & Harren F.J. M., 2002. Ethylene production by *Botrytis cinerea in vitro* and in tomatoes. *Applied Environment Microbiology*, 61 (1): 5342–5350.

Chuku E.C., Osakwe J.A & Daddy-West., 2010. Fungal spoilage of tomato (*Lycopersicon esculentum* Mill.), using garlic and ginger. *Scientia African*, 9 (2): 41-51.

Djeugap J.F., Fontem D.A. & Tapondjou A.L. 2011. Efficacité *in vitro* des extraits de plantes contre le mildiou (*Phytophthora infestans*) de la morelle noire.*Int. J. Biol. Chem. Sci*. 5(6) : 2205-2213.

Fanasca S., Colla G., Maiani G., Venneria E., Rouphael Y., Azzini E. & Saccardo F., 2006. Changes in antioxidant content of tomato fruits in response to cultivar in nutrient solution composition. *Journal of Agricultural and Food Chemistry*, 54 (12): 4319-25.

FAO, 2006. "Indicateurs de l'alimentation et de l'agriculture: Cameroun", novembre. Consulté sur: http://www.fao.org/ES/ESS/fr/compendium_2015/pdf/CMR_ESS_F.pdf.

FAOSTAT, 2014. FAO of the UN. Accessed on http://faostat.fao.org/site/567/default#ancor

Faozia I. & Nowra A., 2014. Evaluation of antifungal activity of some plant extracts and their applicability in extending the shelf life of stored tomato fruits. *Journal of .food process technology*, 5 (6): 2157-7110.

Ijato J.Y., Oyeyemi S.D., Ijadunola J.A. & Ademuyiwa J.A., 2010. Allelopathic effect of leaf extract of *Azardirachta indica* and *Chromolaena odorata* against post harvest and transit rot of tomato (*Lycopersicum esculentum* L.). *Journal of American Science,* 6 (12): 1595-1599.

Keuete K.E., Tsopmbeng N.G., Yaouba A., Djeugap F.J. & serferbe S., 2015. Antifungal potential of some plant extracts against three post-harvest fungal pathogens of avocado (*Persea americana* Mill.) fruits. *International Journal of Multidisciplinary Research and Development*, 2 (4): 148-152.

Kra K.D., Diallo H.A. & Kouadio Y.J., 2009. Activités antifongiques de l'extrait de *Chromolaena odorata* sur deux isolats de *Fusarium oxysporum* responsables du jaunissement mortel des feuilles des bananiers. *Journal of Applied Biosciences,* 24: 1488-1496.

Kutama A.S., Aliyu B.S. & Mohammed I., 2007. Fungal pathogens associated with tomato wicker baskets. *South West Journal*, 2 (1): 38-39.

Ling B., Zhang M., Kong C, Pang X. & Liang G., 2003. Chemical composition of volatile oil from *Chromolaena odorata* and its effects on plant, fungi and insect growth. Ying Yong Sheng Tai Xue Bao , 1-744 p.

Maserejian N.N., Giovannucci E., Rosner B. & Joshipura K., 2006. Propective study of vitamins C, E, and A and carotenoids and risk of oral premalignant lesions in men. *International Journal of cancers,* 54 (25):9592-9597.

Naika S., Joep V.L.J., Marja G., Martin H. & Barbara V.D., 2005. La culture de la tomate. Production, transformation et commercialisation Agrodok (Agromisa Knowledge Center for Small Scale Sustainable Agriculture, Wageningen) Pays-Bas, 5eme édition, 105 p.

Njimah M.D., 2016. Champignons associés à la pourriture des fruits de tomates et essai de lutte antifongique par l'utilisation des poudres de plantes. Thèse de *Master of Science (M. Sc),* Université de Dschang, 77p.

Noudogbessi J.P., Kossou D. & Sohounhloue C.K., 2008. Composition Chimique et Propriétés Physicochimiques des Huiles Essentielles de *Pimenta racemosa* (Miller) et de *Chromolaena odorata* (L. Robinson) Acclimatées au Bénin. *Journal de la Société ouest-africaine de chimie,* 26 : 11-19..

Pamo T.E., Tapondjou L., Tendonkeng F., Nzogang J.F., Djoukeng J., Ngandeu F. & Kana J.R., 2003. Effet des huiles essentielles des feuilles et des extrémités fleuries de *Cupressus lusitanica* sur la tique (*Rhipicephalus lunulatus*) à l'Ouest-Cameroun. *Revue de l'Académie des Sciences du Cameroun*, **3** (3): 169-175.

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Ozbay N. & Newman S.E., 2004. *Fusarium* crown and root rot of tomato and control methods. *Plant Pathology Journal*, 3: 9-18.

Owolade B.F. & Osikanlu Y.O.K., 1999. Evaluation of some plant extracts for the control of Brown Blotch Disease of cowpea is south western Nigeria. *Journal of Sustainable Agriculture and Environment*, 1 (2): 196-202.

Rock Giguere, 2015. La culture de la tomate au Cameroun, htt://www.domainejoly. com/fr/nouvelles/2015/01/08/la- culture -de- la tomate-au-Cameroun/ consulté le 30 Décembre 2015.

USAID, 2006. La filière tomate cerise en Guinée: situation actuelle et perspective de développement des exportations en Guinée. Rapport Final. Chemonics International Inc., Guinée , 24 p.

Swami C. S. & Alane S.K., 2013. Efficacy of some botanicals against seed-borne fungi of green gram (*Phaseolus aureus* ROXB). *Bioscience Discovery*, 4 (1): 107-110.

Wojcik M.,Burzynska-Pedziwiatr I. & Woznia L.A., 2010. Review of Natural and Synthetic Important for Health and Longevity. *Current Medicinal Chemistry*, 17(28):3262-888.