P-ISSN: 2305-6622; E-ISSN: 2306-3599

International Journal of Agriculture and Biosciences

www.ijagbio.com; editor@ijagbio.com

Research Article

Influence of Compost types and Fungicide Application on Plant Growth and Suppressiveness of Cocoyam [*Xanthosoma sagittifolium* (L.) Schott] Root Rot Disease

Djeugap FJ[1]*, AT Azia[1, 2], NC Tita[3], D Eko[1] and DA Fontem[1]

[1]Plant Pathology Laboratory, Department of Plant Protection, Faculty of Agronomy and Agricultural Science, University of Dschang, PO. Box 222 Dschang, Cameroon; [2]School of Agriculture and Natural Resources, Catholic University Institute of Buea, Cameroon; [3]Regional Delegation for Agriculture and Rural Development, North West Region, Nkwen-Bamenda, Cameroon

***Corresponding author:** joseph.djeugap@univ-dschang.org

Article History: Received: October 23, 2015 Revised: December 22, 2015 Accepted: January 21, 2016

ABSTRACT

The aim of this study was to test the hypothesis that composts and fungicide application on suckers could control root rot disease of cocoyam, a major disease constraint of the production of this crop in Cameroon. Experiment was conducted in a screen house through a complete randomized design with five replicates. Eight compost types made from four different abundant and locally available weed species (Gramineae family) mixed either with poultry or pig manure were prepared. Mature compost was inoculated 48 hours before planting to enable compost-pathogen interaction. Plant growth parameters were highest in compost made from *Tithonia diversifolia* compare to others compost types. Disease incidence and severity was significantly (P≤0.05) reduced in all compost amended pots than in control at 12 weeks after inoculation. The most suppressive compost was compost made from *T. diversifolia* followed by *Chromolaena odorata* both associated with poultry manure. These compost types registered the least disease incidence (DI) (24.5% and 30.9%) and severity (0.8 and 1.6) respectively. Plants which received both compost and fungicide were healthier compared to those that received only compost irrespective of weeds species and animal dung. Compost made from *T. diversifolia* and *C. odorata* associated with fungicide Ridomil Plus application on suckers is recommended for the control of root rot disease of cocoyam.

Key words: Organic amendment, Ridomil Plus, Macabo, Root rot disease, Disease control

INTRODUCTION

Cocoyam [*Xanthosoma sagittifolium* (L.) Schott] from the Araceae family, commonly called white macabo is mostly cultivated for its tubers but almost all the plant parts (corms, cormels, flowers and leaves) are consumed (Schafer, 1999; Agueguia, 2000). In Cameroon, the tuber crop is cultivated in almost all the agro-ecological zones of the country. However, yields are still very low due to the root rot disease (*Pythium myriotylum* Dreschl). The pathogen lives in the soil and causes stunted growth, leaf yellowing and roots rot (Nzietchueng, 1985; Tambong *et al*., 1999) and yield losses of 90% in Cameroon (Acquah *et al*., 1994; Perneel *et al*. 2006). The use of cultural practices does not provide sustainable management of the disease (Acquah *et al.* 1994) and farmers try to establish cocoyam plantations on virgin soils but without much success in disease control due to the use of infected planting materials and limited access to arable land. High disease incidence and severity in most cocoyam fields are partly due to the use of infected planting materials, poor management of cocoyam residues and low soil organic matter content (Schafer, 1999). Due to the difference in genetic base and rareness in flowering, research to develop high yielding cocoyam cultivars resistant to the root rot disease were not successful (Boudjeko *et al.* 2005; 2006; Perneel *et al*., 2006). However, it was established that incorporation of organic amendments such as plant residues, green manure, farmyard manure and composted organic material to soil, is one of the approaches used to improve soil fertility, crop yield and reducing incidence of some soil-borne plant pathogens like fungi belonging to the genus *Pythium* (Hoitink *et al.,* 1997; Darby *et al.* 2006). Numerous compost types have been reported to

Cite This Article as: Djeugap FJ, AT Azia, NC Tita, D Eko and DA Fontem, 2016. Influence of compost types and fungicide application on plant growth and suppressiveness of cocoyam [*Xanthosoma sagittifolium* (L.) Schott] root rot disease. Inter J Agri Biosci, 5(1): 32-37. www.ijagbio.com

suppress soil-borne plant diseases (Steven *et al.* 2004; Djeugap *et al.* 2014a; Tita *et al.,* 2015). It is the case of compost made from sewage sludge which was proven to control bean blight caused by *Pythium myriotylum* (Lumsden *et al.* 1983). Also, application of pesticides to soil can decrease its pest's population (Lodha and Burman 2000). Despite the fact that there exist a variety of research efforts on the use of compost to control soil-borne pathogens, little information is known on the use of composts made from weeds species such as *Tithonia diversifolia*, *Pennisetum purpureum*, *Chromolaena odorata* and *Ageratum conyzoides* in the control of disease caused by *P. myriotylum.* The aim of the study was to evaluate the effect of compost types made with these grass species and fungicide application on the control of cocoyam root rot disease.

MATERIALS AND METHODS

Study area

The study was conducted in the Application Research farm (Faculty of Agronomy and Agricultural Sciences, University of Dschang); altitude: 1400 m, latitude: between 5°10' and 5°30'N and longitude: between 9°50'and 10°20'E. The climate is sudano-guinnean with two seasons: a long rainy season (from mid-March to mid-November) and a short dry season (from mid-November to mid-March). The average rainfall of the locality ranges between 1800-2000 mm annually, while temperatures range from 21-24^{o}C. The relative humidity is generally above 60% even during dry season.

Compost composition and preparation

Eight compost types were prepared using four different grass species based on their availability and previous research work. The grass species used were *Tithonia diversifolia, Chromolaena odorata, Pennisetum purpureum* and *Ageratum conyzoides* which are commonly considered as weeds. An amount of 25 kg of each plant species and 10 kg of animal dung were used for preparation of each compost type. These plant species were chopped into pieces of 5 to 10 cm to facilitate decomposition and poultry and pig manure were added separately to ameliorate the efficiency and quality of the compost according to protocol describe by Djeugap *et al.* (2014a and b).

Isolation of the pathogen, preparation of planting material, inoculation technique and experimental design

Pieces of disinfected roots rot were put on a sterilised potato dextrose agar (PDA) medium (autoclaved at 121°C for 15 min) amended with 500 mg of chloramphenicol (per litre) for the culture of the pathogen. A pure culture of *Pythium myriotylum* was blended in sterilised distilled water for 2 min to produce inoculum in form of solution (Adiobo, 2006). Two-month old white cocoyam suckers of average weight 75 g were obtained from local farmers in Lewoh, Lebialem Division. Suckers were soaked in 15 litres of water mixed with 50 g of Ridomil Plus 66 WP (contact and systemic fungicide: 6% metalaxyl + 60 % copper oxide, known to be effective against *Pythium* species) for 12 h to ensure proper disinfection (Adiobo, 2006). Then, the suckers were dried for 24 h at room temperature before planting (Adiobo, 2006; Agueguia, 2008). Control suckers did not receive fungicide treatment. In the screen house, the pots were arranged in a completely randomised design with 9 treatments and 5 repetitions. Polyethylene bags of 30 cm × 25 cm were filled with compost and soil in a 1:1 ratio (2 kg compost and 2 kg of soil/bag/plant) and then inoculated with 18.5 ml inoculum (10^{3}sporangia/ml) and kept for 48 h to allow pathogen interaction with the compost before planting. Data was collected from the 6th week at two weeks intervals to 12 weeks after planting (WAP) from five sample plants selected from each treatment. A total of 270 suckers were used for the trial.

Assessment of plant growth parameters

Growth parameters that were measured were plant height, plant vigour and leaf area. Plant height was determined by measuring the petiole length of each plant per treatment using a measuring tape. The measurement started from the point of corm attachment to the base of the leaf blade of the longest petiole. Plant vigour was estimated using the Wutoh *et al.* (1994) rating scale which varies from 0 to 5 where 0 = dead plants, 1 = very bad plants, 2 = average plants, 3= fairly good plants, 4 = good plant and 5 = very healthy plants. With regards to the leaf area (LA), the length and width of each leaf per plant were measured using a transparent graduated ruler and the LA (cm^{2}) per plant determined using the formula: LA = k × LW where k = 0.923 (constant), L = leaf length (cm) and W = leaf width (cm) (Agueguia, 1993).

Assessment of disease parameters

Disease parameters that were measured are leaf disease incidence, disease severity, root disease incidence and root disease severity. Leaf disease incidence (LDI) expressed in percentage was determined 6 WAP using the formula: LDI (%) = (number of infected leaves of the plant/total number of leaves of the plant) × 100. Disease severity (DS) represents the intensity of the yellowing of the leaves as a result of root infection by *Pythium myriotylum*. The DS was determined using the Nzietchueng (1985) rating scale which varies from 0 to 4 where 0 = no symptom on leaves or healthy plant, 2 = 1 to 2 yellow leaves (1-25%), 2 = 3 yellow leaves (26 - 40%), 3 = 4 to 5 yellow leaves (51 - 75%) and 4 = all leaves yellow (76 -100%). To determine disease at the level of roots, a destructive sampling method was conducted on all the five plants per treatment (as they were carefully uprooted for observation) by counting of infected (necrotic) roots. Root disease incidence (RDI) = (number of infected roots of the plant/total number of roots of the plant) × 100. Root disease severity (RDS) represents the intensity of necroses or rottenness of the root. This was determined using the Hountondji (1986) rating scale which varies from 0 to 4 where 0 = healthy roots, 1 = roots with necrotic points, 2 = roots with necrotic points of at least 1 cm, 3 = roots with necrotic points half the length of the root, 4 = roots completely destroyed.

Data analysis

Data were subjected to analysis of variance (ANOVA) using the general linear model procedure of SAS (Statistical Analyses System) (SAS, 1998). Data in percentage was transformed by arcsin (x) prior to analyses. Where a significant treatment effect was measured by ANOVA, means were separated using Fisher's protected Least Significance Difference (*LSD*) test at $P<0.05$.

RESULTS

Influence of compost amendment and fungicide application on plant growth parameters

All the plants that received compost had the highest height, vigor and leaf area than those that received soil (control). Plants which received compost made of *T. diversifolia* mixed with either poultry or pig manure registered the highest plant height (59.7 and 56.7 cm, respectively), vigor (4.6 and 4.3 respectively) and leaf area (280.5 and 270.8 cm^2 respectively) while those that received compost made of *A. conyzoides* had the lowest height (36.2 and 30.5 cm respectively), vigor (2.2 and 1.6 respectively) and leaf area (192. 8 and 184.1 cm^2 respectively). There was no significant difference in plant growth parameters between plants that received only compost and plants that received compost and fungicide ($P\geq0.05$). Compost with pig manure improved all the growth parameters of cocoyam plant compared to pig manure (Table1).

Influence of compost amendment and fungicide application on disease incidence and severity on cocoyam leaves

Inoculation of compost with *P. myriotylum* 48 h before planting enabled the development of typical symptoms of the root rot disease (leaf yellowing and stunting of the plant) 6 weeks after planting (Figure 1). Disease incidence and severity on leaves in plants that received compost was lower than in plants that received soil (control). Plants which received compost amendments of *T. diversifolia* gave the least disease incidence and severity (16.7% and 0.8% respectively) compared to others compost types. There were significantly differences ($P<0.05$) in LDI and DS between compost amendments of *T. diversifolia* and other compost types. Plants that received compost of *A. conyzoides* developed the highest level of LDI and DS (45.2 and 3.6% respectively) irrespective to the animal dung (Table 2). The association of compost types + fungicide application significantly reduces LDI and DS in all the compost types compared to pure compost types. LDI on plants which received compost mixtures with poultry manure (without fungicide application) were significantly higher ($P<0.05$) compared to plants that received compost mixtures with pig manure (Table 2).

Influence of compost amendment and fungicide application on disease incidence and severity on cocoyam roots

Inoculation of compost with the pathogen before planting induced root rots intensities that varied from one compost type to another. The highest root disease incidence and root disease severity were observed in plants which received only soil (89.6 and 3.8% respectively). Plants which received compost mixtures of *T. diversifolia* gave the least root disease incidence (26.4 and 24.5% with pig and poultry manure respectively).

Fig. 1: (A and B) Cocoyam plant inoculated with compost from *T. diversifolia;* (A= no symptom yet both on leaves and roots, 4 weeks after planting and B = Cocoyam with symptoms, 6 weeks after planting; (C) = Yellow and stunted cocoyam plant from soil (control).

Table 1: Influence of compost types and compost associated with fungicide application on cocoyam's height, vigor and leaf area, 12 weeks after plantings (n = 5); n is the number of plants per treatment.

Compost types	Plant height (cm)		Plant vigor		Leaf area (cm^2)	
	Compost	Compost + fungicide	Compost	Compost + fungicide	Compost	Compost + fungicide
T. diversifolia + poultry manure	59.7a	61.4a	4.6a	4.8a	280.5a	287.6a
T. diversifolia + pig manure	56.7ab	59.3ab	4.3ab	4.6ab	270.8b	276.6b
C. odorata + poultry manure	53.5b	55.2b	3.8b	4.2b	245.9b	249.7b
C. odorata + Pig manure	50.2bc	52.5bc	3.4bc	4.0bc	233.8c	234.2c
P. purpureum + poultry manure	46.2c	48.8c	3.0c	3.8c	218.6d	221.6d
P. purpureum + Pig manure	42.9cd	45.2cd	2.6cd	3.2cd	215.8ef	219.5def
A. conyzoides + poultry manure	36.2d	42.7d	2.2d	2.8d	192.8f	198.9f
A. conyzoides + pig manure	30.5e	39.7e	1.6de	1.8de	184.1g	186.7g
Soil (control)	24.5f	28.3f	1.0e	1.2e	160.9h	168.6h

Means within a column followed by the same letter are not significantly different according to Fisher's protected Least Significance Difference test at 5%.

Table 2: Disease incidence (%) and severity on cocoyam's leaves with respect to compost types and compost associated with fungicide application, 12 weeks after planting (n = 5).

Compost types	Disease incidence		Disease severity	
	Compost	Compost + fungicide	Compost	Compost + fungicide
Soil (control)	73.6a	60.4a	4.1a	3.1a
A. conyzoides + pig manure	45.2b	43.2b	3.6b	2.8b
A. conyzoides + poultry manure	42.1bc	40.0bc	3.2c	2.6bc
P. purpureum + pig manure	32.4c	30.4d	2.6d	2.2c
P. purpureum + poultry manure	29.5d	27.2ed	2.4de	1.8d
C.odorata + pig manure	24.2e	22.2f	1.5f	1.4de
C. odorata + poultry manure	22.6ef	20.6fg	1.3ef	1.0e
T. diversifolia + pig manure	19.2g	17.3h	1.1fg	0.9e
T. diversifolia + poultry manure	16.7gh	15.0hi	0.8g	0.6ef

Means within a column followed by the same letter are not significantly different according to Fisher's protected Least Significance Difference test at 5%.

Table 3: Disease incidence (%) and severity on cocoyam's roots with respect to compost and compost associated with fungicide application, 12 weeks after inoculation (n = 5).

Compost types	Disease incidence		Disease severity	
	Compost	Compost + fungicide	Compost	Compost + fungicide
Soil (control)	89.6a	75.4a	3.8a	3.2a
A. conyzoides + pig manure	47.6b	44.4b	2.8b	2.4b
A. conyzoides + poultry manure	45.2bc	42.2bc	2.6b	2.0bc
P. purpureum + pig manure	42.6c	36.4c	2.4c	1.6c
P. purpureum + poultry manure	40.8cd	34.4cd	2.2cd	1.4cd
C.odorata + pig manure	32.4d	30.1d	1.8d	1.2d
C. odorata + poultry manure	30.9de	28.3de	1.6d	1.0d
T. diversifolia + pig manure	26.4e	24.8e	1.2e	0.8d
T. diversifolia + poultry manure	24.5ef	22.7ef	0.8e	0.6d

Means within a column followed by the same letter are not significantly different according to Fisher's protected Least Significance Difference test at 5%.

There was no significant difference between roots disease severity in compost made up of *C. odorata* and *T. diversifolia* when fungicide was applied (Table 3). The least disease suppressive effect was observed in plants which received compost made of *A. conyzoides* (47.6 and 45.2% with pig and poultry manure respectively). The association of compost type with fungicide application had a positive effect on root rot suppressiveness of cocoyam.

DISCUSSION

Results have shown that plant height, plant vigour and leaf area were high for plants grown in compost made up *T. diversifolia* than in other compost types. This could be due to its chemical composition which is made up of N, K, Ca, Na and Mg (Gachengo *et al*. 1999; Djeugap *et al*. 2014b) and to the highest level of cation-exchange capacity (CEC) that allow a high retention level of nutrients for roots of the plants (Djeugap *et al*. 2014b). In fact, Agrios (1997) reported that suppressive soils rich in N, P, K, Ca, Na and Mg were more fertile than conducive soils with very low nutrient content as plants grow faster in fertile soils thus escaping some soil borne diseases. Other research works have shown the effect of compost to improve plant growth. Indeed, McConnell *et al.* (1993) reported that applying compost at 38 to 75 t/ha increases the CEC of the most mineral agricultural soils by 10% producing very healthy and gigantic plants. The study by Hoitink *et al*. (1997) showed that increase in soil nutrient level through compost amendments could influence the pathogen's environment negatively by inhibiting its growth, therefore, favouring rapid growth of the plant. Hence, the lowest plant height observed in *A. conyzoides* compost and in the control might indicate the highest disease pressure exerted on the plants due to very low mineral nutrients and the absence of compost amendments (control) respectively. A research conducted on the chemical analysis of the soil where this study was done revealed that the soil has very low CEC, organic matter and nutrient content explaining it's the lowest plant height and vigour in control soils. Also, highly evolved ferralsols are the commonest soil types found in this geographical zone and according to Adiobo (2006), ferralsols are very conducive soils for the root rot disease. Compost with poultry manure was more suppressive than compost with pig manure. This could be due to its very high value of nitrogen (facilitate rapid growth); also, poultry manure has large quantity of antibiotics residues (antibiotics are common used as additives to poultry diets by farmers); animals discharge in their feces and urine between 70 to 90% of the antibiotic administrated unchanged or in active metabolites (Masse *et al.* 2014). It will be important to study later the effect of poultry manure on the capability of the plant to develop induced resistance to pathogens. Also, Tambong *et al.* (1999) showed that the antagonistic property induced by specific microbial metabolites such as antibiotics and pathogenic cell wall degrading enzymes from compost, suppress *Pythium* spp development by inducing systemic resistance and thus enabling the plant to develop a defence mechanism towards the pathogen. The mechanisms by which pathogens are suppressed in the soil by compost include induced resistance, nutrient competition and direct inhibition through antibiotics secreted by beneficial microorganisms of the compost (Darby *et al*. 2006). Ringer *et al.*, (1997) showed that the suppression of damping-off of cotton caused by *P. ultimum* was related to the reduced *P. ultimum* sporangium germination following compost amendments while Nyochembeng *et al.* (2002) established that mineral nutrient concentration in compost, contribute to the disease suppressive effect and that high calcium content in suppressive compost affects sporangia of *P. myriotylum* by enhancing zoospores production. Plants treated with the association compost + fungicide gave the least disease incidence and severity compared to plants which received only compost treatment irrespective of animal dung. Indeed, the fungicide treatment administered to the suckers before planting has retarded the infection of the pathogen. This is in relation to Nzietchueng (1985) findings which showed that the use of metalaxyl at a dose of 10 g active ingredient/m²/plant reduces the disease severity by 80% though the disease suppressive effect of most chemicals is short lasting (three-four weeks for metalaxyl).

Conclusion

In this study we have presented evidence for the role of compost to improve cocoyam growth and its capability of control root rot disease of cocoyam. The effect of compost was improved when fungicide Ridomil Plus was applied. Based on the results generated, two compost types (*T. diversifolia* and *C. odorata*) have increase plant growth parameters and reduce root rot intensity and severity than others. These available, abundant and invasive weeds that are near farmer's farm are recommended to be used by farmers either to manufactured compost (mixed with poultry manure) or to plant them directly in sterile and/or conducive soils to improve soils fertility and control of soil-borne diseases such as root rot of cocoyam.

Acknowledgements

The authors are grateful to Dr. Amayana Adiobo, head of the Biotechnology Laboratory, Research Institute for Agricultural Development at Ekona (Cameroon) for technical assistance. The Plant Pathology Lab of the University of Dschang for the funding and Titilayo Falade (Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Australia) for the correction of the English language.

REFERENCES

Acquah ET, A Nnoung, A Mbassa and JC Mboua, 1994. Macabo root rot disease in Cameroon: Knowledge, Occurrence and Incidence in Fako Division, in: Ofori F & SK Hahn (editors). Tropical Root Crops in a Developing Economy. Proc.of the 9th Symp. ISTRC. Accra-Ghana. pp: 446-472.

Adiobo A, 2006. Biological control of cocoyam (*Xanthosoma sagittifolium* (L.) Schott) root rot disease caused by *Pythium myriotylum* Dreschl: importance of soil organic matter content and cultural practices. PhD thesis. University of Gent, Belgium, 176p.

Agrios GN, 1997. Induced structural and biochemical defences. Plant Pathology (4th Ed). Academic Press. San Diego, California, USA, pp: 93-144.

Agueguia A, 1993. Non-destructive estimation of leaf area in cocoyam (*Xanthosoma sagittifolium* (L.) Schott). Agron Crop Sci J, 171: 138-141.

Agueguia A, 2000. Importance and uses of cocoyam in Cameroonian diets, in: Nakatani & K Komati (editors). 20th Symposium of the International Society for Tropical Root Crops (ISTRC). IPGRI Session. Tsukuba Japan, pp: 550-560.

Boudjeko T, ND Omokolo, A Drioch and AP Balange, 2005. Peroxydases and pectin methyl esterase activities in cocoyam (*Xanthosoma sagittifolium* (L). Schott) roots upon *Pythium myriotylum* inoculation. J Phytopathol, 153: 409-416.

Boudjeko T, C Adème-Onzighi, M Vicré, AP Balange, DO Ndoumou and A Driouich, 2006. Loss of pectin is an early event during infection of cocoyam roots by *Pythium myriotylum* pectin methyl esterase activities in cocoyam (*Xanthosoma sagittifolium* (L.) Schott) roots upon *Pythium myriotylum*. Planta, 223: 271-282.

Darby HM, AG Stone and RP Dick, 2006. Compost and manure mediated impacts on soil-borne pathogens and soil quality. Soil Sci Soc Amer J, 70: 347-358.

Djeugap FJ, D Eko, J Nguefack, NC Tita and DA Fontem, 2014a. Effect of organic amendments and fungicide application on potato late blight, bacterial wilt and yield in Cameroon. Inter J Agric Agricult Res, 5: 12-19.

Djeugap FJ, TA Azia and DA Fontem, 2014b. Effects of compost quality and microbial population density of composts on the suppressiveness of *Pythium myriotylum*, causal agent of cocoyam root rot disease in Cameroon. Inter J Sci: Basic Appl Res, 15: 209-218.

Gachengo CN, CA Palm, B Jama and C Othieno, 1999. *Tithonia* and *Senna* green manures and inorganic fertilizers as phosphorus sources for maize in western Kenya. Agroforestry Systems, 44: 21-36.

Hoitink HAJ, AG Stone and DY Han, 1997. Suppression of plant diseases by compost. Horticult Sci J, 32: 184-187.

Hountondji AC, 1986. Etudes sur les causes de dépérissement du chou carabe, *Xanthosoma sagittifolium* (L.) Schott dans les Antilles. Thèse de doctorat 3ème cycle. Université de Re*n*nes, France 94p.

Lodha S and U Burman, 2000. Efficacy of compost on nitrogen fixation, dry root rot (*Macrophomina phaseolina*) intensity and yield of legumes. Indian J Agric Sci, 70: 846-849.

Lumsden RD, R Garcia, JA Lewis and PD Millner, 1983. Effect of composted sewage sludge on several soil-borne pathogens and diseases. Phytopathology, 73: 1543-1548.

Massé DI, NMC Saady and G Yan, 2014. Potential of biological processes to eliminate antibiotics in livestock manure: An Overview. Animals, 4: 146-163.

Nyochembeng LM, RP Pacumbaba and CA Beyl, 2002. Calcium enhanced zoospore production of *Pythium myriotylum in vitro*. Phytopathology, 150: 396-398.

Nzietchueng S, 1985. Genre *Xanthosoma sagittifolium* (macabo) et contraintes de production: cas de la pourriture racinaire causé par *Pythium myriotylum* Dreschl au Cameroun. Thèse Doctorat Etat. Université de Yaoundé, Cameroun, 253p.

Perneel M, JT Tambong, A Abiobo, C Floren, F Sabario, A Leveque and M Hofte, 2006. Intraspecific variability of *Pythium myriotylum* isolated from cocoyam and other host plants. Mycolog Res, 110: 583-593.

Ringer CE, PD Millner, LM Teerlinck and BW Lyman, 1997. Suppression of seedling damping-off in potting mixes containing animal manure compost. Compost Science and Utilization, 5: 6-14.

SAS Institute, 1998: PROC Users' Manual. SAS InstituteInc., Cary.

Schafer JL, 1999. Amélioration du système de culture du macabo (*Xanthosoma sagittifolium* (L.) Schott) en pays Bamiléké (Ouest- Cameroun). Cahier Agriculture, 8: 9-20.

Steven JS, MS Dan and FM Walter, 2004. Suppression of seedling damping-off caused by *Pythium ultimum, P. irregulare* and *Rhizoctonia solani* in container media amended with a diverse range of pacific North West compost sources. Compost Science, 20: 89-95.

Tambong JT, X Ndzana, JG Wutoh and R Dadson, 1997. Variability and germplasm loss in the Cameroon national collection of cocoyam (*Xanthosoma sagittifolium* L. Schott). Plant Gen Resour, 112: 49-54.

Tambong JT, J Poppe and M Hofte, 1999. Pathogenicity and electrophoretic characterisation and detection of the root rot disease pathogen, *Pythium myriotylum.* Europ J Plant Pathol, 105: 597-607.

Tita C, FJ Djeugap and TA Azia, 2015. Effects of compost amendments on the suppressiveness of bacterial wilt (*Ralstonia solanacearum* (Smith) Yabuuchi) of potatoes in western Highland of Cameroon. Inter J Multidiscip Res Develop, 2: 691-695.

Wutoh JG, JT Tambong, MM Meboka and S Nzietchueng, 1994. Field evaluation of cocoyam (*Xanthosoma sagittifolium* (L.) Schott for tolerance to the root rot disease caused by *Pythium myriotylum,* in: Ofori F & SK Hahns (editiors), Tropical Root Crops in a Developing Economy. Proc of the 9th Symp. ISTRC Accra- Ghana, pp: 462-466.