Farmers' knowledge and perception of the dry cassava root rot disease in Brong Ahafo region of Ghana

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ABSTRACT

Cassava root rot disease caused by soil-borne pathogens cause substantial yield loss in cassava production. Recently cassava root rot disease caused by *Lasiodiplodia theobromae* was widespread in the Brong-Ahafo region of Ghana. Seventy cassava farmers were randomly selected from each of the following Districts of the Brong-Ahafo Region: Dormaa East and Sunyani West Districts and the Nkoranza South Municipal. The farmers were interviewed face to face using a structured questionnaire to obtain information on their knowledge and perception on the cassava root rot disease. Data collected were analyzed using descriptive statistics. All the respondents (100%) identified the dark brown fragmented storage root tissue symptom as the final stage of the disease but only 17.1% identified all the symptoms of the disease. Most of the respondents (74.3%) emphasized that cassava root rot disease occur throughout the year but incidence was higher in the rainy season. Only 36.7% indicated that the disease spreads through the soil. Majority (91.4%) reported high rainfall and high temperatures as the cause of the disease; 40% indicated cultivation of susceptible cassava varieties; 60% mentioned delayed harvesting; 41.1% indicated cultivating in waterlogged soils; 6% attributed the disease to glyphosate application; 5.2% indicated high weed density, but none mentioned continuous cropping of cassava as the cause of cassava root rot. Findings reveal that farmers have a fair knowledge of the disease but they lack methods to control the disease. Appropriate cultural practices and disease tolerant varieties need to be adopted to control the cassava root rot disease effectively.

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Introduction

Cassava (*Manihot esculenta* Crantz) is the third most important source of calories after rice and maize in many countries of the tropical world including sub-Saharan Africa (FAO, 2002). In Ghana, cassava is grown across all agro-ecological zones and ranks first in the area under cultivation and utilization. Cassava constitutes 22% of Ghana's Agricultural Gross Domestic Product (Angelucci, 2013).

Cassava root rot disease (CRRD) caused by soil-borne pathogens that attack the roots prior to harvest causes substantial yield loss in cassava production in countries in sub-Saharan Africa including Ghana (Makambila 1994; IITA, 1990). Investigations have identified the soil borne fungi *Phytophthora drechsleri* Tucker; *Fusarium oxysporum* Schlecht, *Lasiodiplodia theobromae* Pat, *Fusarium solani* (Mart) Sacc., and *Macrophomina phaseolina* (Tassi) as the pathogens of cassava root rot (Okigbo *et al*., 2009; Bandyopadhyay *et al*., 2006; Msikita *et al*., 2005; Mwangi, *et al*., 2004; Onyeka, 2002; Makambila, 1994) as the

pathogens of cassava root rot. Environmental factors such as high rainfall, high humidity; high temperature, water logging conditions in the soil and low soil fertility promote cassava root rot infection (Bua and Okello, 2011; Aigbe and Remison, 2010; Banito *et al*., 2010; Waller 1986). In addition cultural practices such as delayed harvesting; continuous cropping of the same piece of land to cassava and planting susceptible cassava varieties enhance the prevalence of cassava root rot disease (Bua and Okello 2011; Mwangi *et al*., 2004). Evidence suggests association of weeds to cassava root rot diseases. Some weeds predispose cassava plants to secondary infection by root rot pathogens while others serve as alternative host to root rot pathogens (Bandyopadhyay *et al*., 2006; Chikoye *et al.*, 2000; Anoka, 1995). Meanwhile the application of herbicides such as glyphosate to control weeds is purported to make plants more susceptible to root rot infection (Jonal and Rahe, 1984; Descalzo *et al*., 1998; Larson *et al*., 2006). Reports indicate that cassava varieties react differently to root rot inducing pathogens; some show susceptibility while others show resistance under field conditions (Okechukwu, *et al*., 2009; Onyeka *et al*., 2005).

Available literature on cassava root rot disease in Ghana has focused on the cassava root rot disease caused by *Polyporus sulphureus* Bull. Ex. Fr. (Opoku-Asiama *et al.*, 1998). Opoku-Asiama *et al.*, (1998) assessed the knowledge of cassava farmers in the Central Region of Ghana on *P. sulphureus* infection and indicated that 68.4% of cassava farmers in the region were aware of cassava root rot disease while 31.6% had encountered it on their farms. Awaga (2004) assessed the extent of spread of *P. sulphureus;* the type of soil associated with the fungus and evaluated the control measures adopted by farmers and the cassava varieties available for disease resistance in the Central Region. The findings from the study revealed that *P. sulphureus* was prevalent at Bobikuma, Kwanyako and Nsaba out of 15 towns covered by the survey. The fungus occurred on all the soil types studied throughout the year, cassava plants aged two to 12 months were affected and the farmers did not have any control measure for the disease. The improved variety Afisiafi was found to be tolerant to *P. sulphureus* while the local cultivar Bosomensia was most susceptible. In 2003 to 2005 Moses *et al*., (2007) carried out a survey of cassava farms in all the southern regions in Ghana except the Brong- Ahafo Region and revealed that *P. sulphureus* was significantly present in Volta, Ashanti and the Central Regions of Ghana. Poor farm sanitation; continuous cropping of the same piece of land to cassava; movement of unprocessed roots and planting materials from endemic areas to new localities and cropping of new fields with strong presence of the fungal pathogen were identified as the cultural practices that promoted the spread and persistence of the disease. The authors also found that some local and improved genotypes of cassava available to farmers were susceptible to the pathogen. Gyan (2009) screened 10 improved varieties of cassava for resistance to *P. sulphureus* in the Western Region of Ghana and found that all varieties except the improved variety Tekbankye were susceptible to the disease.

Recently, cassava root rot disease caused by *L. theobromae* was reported widespread in matured cassava fields in the Brong Ahafo region (Akrofi *et al*., 2016). Symptoms of the disease appear as dark brown patches in the storage root tissue, wilting, browning and defoliation of the leaves when majority of the storage roots are rotten and the rot has extended to the base of the plant and then there is lodging of the whole cassava plant. The cassava plants appear healthy when few storage roots are affected and so the damage caused by the disease as this stage is not visible until harvested. Adequate information on farmers' knowledge and perceptions of the cassava root rot disease is essential to the development of an effective disease management strategy. This paper, reports results of a cross-sectional survey conducted in the major cassava producing areas of Brong-Ahafo

Region to determine farmers' knowledge and perception of the cassava root rot disease.

Materials and methods

Study areas

The study was conducted between April and July 2016 in three districts of the Brong-Ahafo region; the Dormaa East and Sunyani West Districts and the Nkoranza South Municipal. These areas were selected based on reported cases of cassava root rot disease. The Dormaa East District is located between latitude 7° 08´ N and 7° 25´ N and longitude 2° 35´ W and 2°48´ W and it is situated in the Forest zone. Sunyani West District is situated between latitudes 7º 19´N and 7º 35´N and longitudes 2º 08´ W and 2º 31´ W and it is also located in the Forest zone. Nkoranza South Municipal lies within latitudes 7º 20″N and 7º55″N and longitudes 1º10″W and 1º55″ W and it is situated in the Forest-Savannah Transition zone. Dormaa East District has mean annual rainfall of 1240mm to 1750mm and the mean monthly temperatures varying between 23 and 33ºC. Sunyani West District has mean annual rainfall average of 1250mm to 1800mm and mean monthly temperature of about 25.5 to 26.5°C. Mean annual rainfall in the Nkoranza South Municipal ranges from 1000mm to 1300mm and mean monthly temperatures are from 26 to 38°C. All the three areas experience an equatorial climate and have a bimodal pattern of rainfall. The major rainy season is experienced from April to June and a minor rainy season from September to November. Agriculture is the main livelihood of the people in all three Districts (GSS, 2014a; b; c).

Sampling procedures

From a list of communities with high intensity of cassava farming complied with the assistance of the District Agriculture officer and local Agricultural Extension staff; seven communities were randomly selected from each of the three districts. Seventy (70) cassava farmers were randomly selected from each district and a total of 210 were interviewed in the study.

TABLE 1

Communities in the three districts selected for the study

Dormaa East District	*Sunyani West District*	*Nkoranza South Municipal*
Kyeremasu	Adentia	Asuano
Wamfie	Odumase	Donkro-Nkwanta
Kofibourkrom	Tanom-Chiraa	Babiani
Amanfe	Nsoatre	Wagadugu
Ampemkro	Asuakwaa	Asuoso
Kwame Danso	Akwaasoa	Jerusalem
Mereinferewo	Kwatire	Sessima

Data collection and analysis

The selected farmers were individually interviewed, face to face, using a structured questionnaire. The questionnaire was used to collect information on socio-demographic characteris-tics of the cassava farmers and their knowledge and perceptions of the cassava root rot disease. Socio-demographic information collected included sex, age, level of education and farming characteristics. Information on know-ledge on cassava root rot disease focused on whether the farmer had observed cassava root rot disease in the farm, symptoms of the disease, crop growth stage of initial infection and period of the year that the disease occurs. Perception of cassava root rot disease was based on the status

of the disease; causes of the disease and mode of disease spread in cassava farms (for example wind, planting material, soil, and insects). Colour photographs of symptoms of the cassava root rot disease were shown to farmers to guide them in identification of the disease. Some qualitative information were recorded especially when such information was given by simple majority. Quantitative data collected were coded and subjected to descriptive statistic consisting of frequencies and percentages using the Statistical Package for Social Science (SPSS) Version 16.0 for Windows (SPSS Inc. 2007) and results were interpreted appropriately.

Results and discussion

Socio-demographic characteristics of the respondents

The overall male to female ratio of the respondents that participated in the study was approximately 1:1, with slightly more females (52.9%) than males (47.1%). More than 70% of the respondents have had some form of formal education: 16.7% had attended Primary, 51.4% Middle school/Junior secondary school education and 5.7% attended Senior Secondary school. About 70% of the respondents had farming as a primary occupation and 58.1% had cultivated cassava for at least 10 years (Table 2). Equal proportions of males and females respondents which consist of individuals with and without formal education engaged in cassava farming because cassava was cultivated as a crop for domestic consumption and also as a crop for income generation (Osei-Adu *et al.*, 2014).

TABLE 2

Summary of the socio-economic characteristics of the respondents for the 3 Districts in Brong Ahafo Region

Characteristics	*Frequency of respondents*	*Percentage (%) of respondents*
Gender		
Male	99	47.1
Female	111	52.9
Education		
Primary	53	16.7
Middle school/Junior Senior Secondary	108	51.4
Senior Secondary School	12	5.7
No formal education	55	26.2
Farming occupation		
Full time	146	69.5
Part-time	64	30.5
Number of years of cassava farming		
Less than 10 years	88	41.9
Ten years and more	122	58.1

Source: *Survey 2016*

Respondents' knowledge of the cassava root rot disease

Figure 1 shows that majority of the respondents (85.2%) identified the dark brown discoloured patches of the storage root tissue as the initial symptom of the cassava root rot disease. However, only 52.3% of the respondents associated the wilting, browning and defoliation of the leaves, lodging of the whole cassava plant and breakage of the stem to the advance stage of the disease. All respondents (100%) identified the dark brown fragmented root tissue symptom as the final stage of cassava root rot disease but only 17.1% identified all the disease symptoms. These results suggest that the farmers are more conversant with cassava root rot disease symptoms on the edible part of the plant. Generally, farmers have good knowledge about easily observable and objects that are important to them (Bentley, 1992).

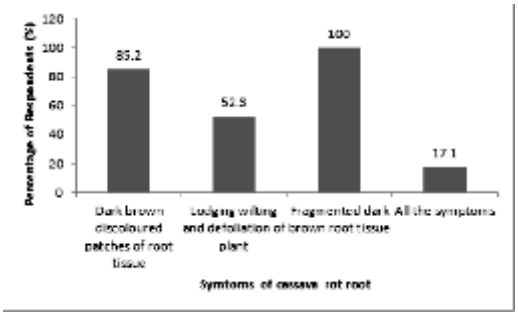

Fig.1. Respondents knowledge on symptoms of cassava root rot disease for the 3 Districts in Brong Ahafo Region

Majority of respondents (91.9%) indicated that the rotten storage roots starts at maturity and increases until harvested (Table 3). This finding disagrees with the report of Mwangi *et al*. (2004) that cassava root rot occur before the cassava reached harvesting stage. Mwangi *et al*. (2004) conducted research on cassava root rot diseases in general while the current study focused on the cassava root rot disease caused by *L. theobromae*. Most of the respondents (74.3%) indicated that cassava root rot disease occurs throughout the year but incidence was higher in the rainy season than at other times of the year (Table 3). According to Msikita *et al*. (2005) and Mwangi et al. (2004) the increase movements of the root rot pathogens in the soil to new areas in the rainy season due to the availability of water in the soil leads to high prevalence of cassava root rot disease (Table 3). More than half of respondents (60.5%) reported to have observed the disease in their fields. This was expected because it is a common practice for farmers in the study area to leave matured storage roots in the ground as a form of storage to be harvested gradually as required or harvested later in bulk for sale. Messiga *et al*. (2004) made similar observations when they carried out a diagnostic survey to investigate biophysical and crop management factors that limit cassava production in Pouma District in Cameroon.

TABLE 3

Respondents' knowledge on the cassava root rot disease for the 3 districts in Brong Ahafo Region

Variable	*Frequency of respondents*	*Percentage (%) of respondents*
Cassava rot root symptoms observed in the field		
Yes	127	60.5
No	83	39.5
Crop growth stage of initial infection		
At maturity	193	91.9
Before maturity	17	8.1
Period of occurrence of CRR		
All year	156	74.3
Rainy season only	54	25.7

Source: Survey 2016

The results obtained suggest that the farmers have fair knowledge of the symptoms of the cassava root rot disease but they lack methods to control the disease. It is, therefore, appropriate to provide these farmers with the necessary information that will enable them to control the cassava root rot disease effectively.

Respondents' perceptions of the cassava root rot disease

Majority of the respondents (62.8%) indicated that the damage caused by cassava root rot disease was a major constraint in cassava production because it reduced the yield and quality of storage roots harvested (Table 4). This is significant because cassava utilization in the study area is mainly in the form of freshly harvested storage roots. Therefore, the occurrence of the cassava root rot disease in the region could be a threat to food security and livelihood.

Only 36.7% of the respondents pointed out that the cassava root rot disease spreads through the soil. Very few (6.2%) of the respondents indicated that the disease was disseminated through planting material. Besides more than half of the respondents (57.1%) had no idea of how the cassava root rot disease spreads (Table 4). It was evident from these responses that the farmers had inadequate knowledge on the mode of spread of cassava root rot disease and they need to be educated.

TABLE 4

Respondents' perceptions of the cassava root rot disease for the 3 districts in Brong Ahafo Region

Variable	*Frequency of respondents*	*Percentage (%) of respondents*
CRR is a major problem		
Yes	132	62.8
No idea	78	37.2
Mode of disease spread		
Soil	77	36.7
Planting material	13	6.2
No idea	120	57.1

Source: Survey 2016

In general, the respondents attributed the cassava root rot disease to unfavourable environmental factors, inappropriate cultural practices and cultivation of susceptible cassava varieties. Majority of the respondents (91.4%) reported that high rainfall and high temperatures were the cause of cassava root rot disease (Fig. 2). This could be attributed to the fact that two of the three districts that the current study was conducted are located in the Forest Zone. It is likely that the Forest Zone with its higher rainfall and higher mean temperature offer a better environment and growth conditions for the cassava root rot pathogens than in the Forest-Savannah Transition Zone. Studies carried out by Onyeka (2002) and Banito *et al*., (2010) showed that cassava root rots roots are more prevalent in the forest areas of Nigeria and in Togo where rainfall is higher and soils do not drain rapidly.

Sixty-nine percent of the respondents attributed the cassava root rot to delayed harvesting of matured storage roots (Fig. 2). Considering that the fungus that induces the cassava root rot is soil-borne the matured storage roots could be exposed to infection when kept in the soil for prolong periods (Mwangi *et al*., 2004). Onyeka (2002) reported very significant increases in rot

intensity when cassava plants were left in the field for up to 15 months after planting in Nigeria.

Cultivating cassava in waterlogged soils was indicated as the cause of cassava root rot by 41.1% of the respondents (Fig. 2). Waller (1986) indicated that waterlogged conditions in the soil promote cassava root rot because the water medium facilitates the dispersal of the cassava root rot fungus.

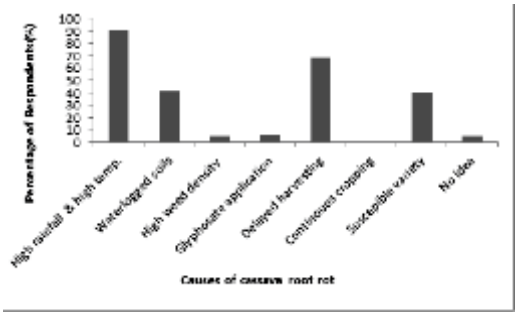

Fig. 2. Respondents' perceptions of the causes of cassava root rot disease for the 3 Districts in Brong Ahafo Region

High weed density in cassava fields was reported to be the cause of cassava root rot disease by 5.2% of the respondents (Fig. 2). This assertion corroborates the reports of Anoka (1995) and Chikoye *et al*., (2000) that the growing rhizomes of *Imperata cylindrical* (L.) Räeuschel pierced right through the storage roots of cassava and predisposed them to secondary infection by soil borne pathogens. Besides Bandyopadhyay *et al*., (2006) demonstrated that *Chromolaena odorata* (L.) King and Robinson a dominant weed in short fallows in humid forest areas served as alternative host when its roots were colonize by the cassava root rot pathogens *Fusarium* spp. and *L. theobromae.*

About 6% of the respondents had the opinion that glyphosate application to control weeds in cassava fields promotes cassava root rot disease (Fig. 2). This claim was confirmed by the results from greenhouse studies carried out by Larson *et al*., (2006) where increased root rot disease severity in glyphosate resistant sugar beet was observed following glyphosate application and inoculation with certain isolates of *Rhizoctonia solani* Kuhn and *F. oxysporum* Schlecht. f. sp. *betae* Snyd. & Hans.

While 5.2% of the respondents indicated that they had no idea of the cause of cassava root rot disease, none of the respondents mentioned continuous cropping of cassava on the same piece of land as a cause of the disease. Farmers in the study area intercropped cassava with maize continuous for a period not less than three years without soil improvement. Cultivating cassava on the same piece of land continuously without soil fertility improvement could lead to soils with low soil fertility. Consequently planting cassava in such infertile soils can affect plant growth and produce weak cassava plants that can easily succumb to diseases. Aweto *et al*., (1992) observed that continuous intercropping of cassava and maize had a greater harmful effect on soil in terms of soil organic, total nitrogen and available phosphorous. Moreover, Entwistle (1990) indicated that the continuous cultivation of cassava on the same field is likely to lead to a buildup of the cassava root rot pathogen population in the soil. Moses *et al*., (2007) also cautioned that cultivation of *cassava crop consecutively* for three years on the *same* field could lead to a build-up of root rot pathogens in the soil.

Forty percent of the respondents stated that cultivation of susceptible local cassava varieties such as Abenewoha and Ahenewa and the improved variety Wenchi leads to a high incidence of the disease. Similarly, Moses *et al*., (2007) found that some local and improved genotypes of cassava available to farmers in some regions in southern Ghana were susceptible to the cassava root rot disease caused by *P. sulphureus*.

Conclusion

It is concluded from the study that farmers in the Brong-Ahafo Region of Ghana have a fair knowledge of the cassava root rot disease in the

region and they lack methods to control the disease. A major concern of the findings obtained was the inability of respondents to perceive the cassava root rot disease as distinct entity. This suggests that there is the need for sensitization and awareness creation of the farmers on the cassava root rot disease, particularly on disease recognition; mode of disease spread, causes of the disease and disease control methods. Nevertheless, relating the cassava root rot disease to inappropriate cultural practices suggests the appreciation of good cultural practices in the management of cassava root rot disease. Farmers need to adopt appropriate cultural practices such planting in well drained soils; maintain weed- free cassava fields, use herbicides efficiently, harvest mature storage roots promptly and cultivate disease tolerant cassava varieties to effectively control the cassava root rot disease.

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