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Fusarium Wilt Disease Of Eggplant: Farmers' Socio-Demographic Characteristics, Farming History, Awareness And Perception In Major Eggplant Growing Areas Of Ghana

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ABSTRACT

Fusarium wilt disease causes losses to eggplants in many parts of Ghana. However, information about farmers' appreciation and management of the disease is limited. In this study, farmers' socio-demographic characteristics, farming history, awareness and perception of Fusarium wilt disease of eggplants in some major eggplant growing areas in the Ashanti, Eastern and Volta Regions of Ghana were determined. Purposive sampling was used to select major eggplant-producing communities, and the snowball technique was employed to identify eggplant farmers. A structured questionnaire aided with pictures of Fusarium-infected eggplant was used to inquire for information from 750 farmers in the three regions; 250 from each region and 50 from each of the 5 communities selected in each region. The farmers in the three regions had similar socio-demographic characteristics and knowledge of the Fusarium wilt disease of eggplants. Farmers were mostly within the age group of 30 years to 50 years, and 63% had formal education. Land preparation was mainly manual, except for some parts of the Volta region that used tractors. Mixed cropping with other vegetables and crop rotation with cereals was most practised. Farmer-selected seeds were the major planting materials. Wilt symptoms were a common observation of farmers in all the regions. However, the majority were oblivious of the cause and source of the disease and, therefore, were unable to apply appropriate management methods.

Farmers could not estimate losses caused by Fusarium wilt disease and, therefore, were not keen on management methods.

Keywords: Fusarium Wilt Disease, Eggplant, Farmers' Awareness, Farmers' Socio-demographics

INTRODUCTION

Eggplant is a vegetable of the Solanaceae

family that is cultivated largely as a source of vitamins, fibers and minerals, and some species are for medicinal uses (Shippers, 2002; Chinedu *et al.,.,* 2011).

Eggplant nutrient constituents such as iron and Vitamin C are comparable to tomato (Okon *et al.,.*, 2010: Horn *et al.,.,* 2007). It is the fifth most consumed vegetable in Ghana, following tomato, pepper, onion and okra. Eggplant production in Ghana has increased steadily and substantially over the last twelve years, from 21584 tones in 2008 to 55092 tonnes in 2019 (World Data Atlas, 2021). It was cultivated on an estimated 6295 Ha of land with an average yield of 8.80 t/Ha in Ghana in 2019 (World Data Atlas, 2021). The increased participation of farmers in eggplant production is due to high demand and profitability. Eggplant is alos a key ingredient in many Ghanaian soups and stews and is also used in many assorted dishes. The produce is consumed locally and exported to African markets in Europe and the United States of America (Saavedra *et al.,.*, 2014; Daunay *et al.,.,* 2001). The domestic market for vegetables, including eggplants in Ghana, has increased due to the spring of chains of supermarkets (Saavedra *et al.,.*, 2014), creating more avenues for sales and increasing the availability of the produce to customers. Additionaly Eggplant can be considered as a target crop for poverty alleviation in Ghana. The crop is globally considered an important food and nutrition security crop, which yields good economic returns (FAOSTAT, 2019). It is cultivated in many rural communities of the Ashanti and Eastern regions of Ghana where the crop has the largest genetic diversity. Genetic diversity of eggplants abounds in Ghana.

Wilt disease accounts for 25% of eggplant yield loss globally, with Fusarium wilt and Verticillium wilt pathogens being the major causal agents of wilt in eggplants (Kouassi *et al.,.*, 2014). Fusarium wilt disease is soil-borne and caused by *Fusarium* species. Fusarium pathogens have a wide host range (Miller *et al.,.,* 2011). Plants of the Solanaceae family; tomato, eggplant, pepper and potato, are particularly vulnerable to this disease. The fungi invade through the roots and obstruct the water-conducting vessels of the plant. As the infection spreads into the stems and leaves, it restricts water flow, causing the foliage to turn yellow and wilt. Fusarium species can survive for years in the soil and are generally spread by water, insects and farm implements. The disease is most prevalent in humid tropics. Generally, wilt symptoms of Fusarium wilt disease appear later in the crop development on the field. However, vascular discolouration, which is asymptomatic, appears earlier and is believed to cause substantial yield losses unaware to the farmer. *Solanum melongena,* which is a commonly used and most commercially produced eggplant species in Ghana, is the most susceptible to Fusarium wilt disease amongst African eggplants (Mwaniki *et al.,.,* 2016), and it is a major challenge to its production.

Cultivation of eggplant in Ghana predates history, progressing from

wild collecting and nurturing to species selections and farm establishment. Indigenous knowledge of eggplant production abounds in the growing areas. Eggplants play a central role in the tradition and culture of people in sub-Saharan Africa (Chinedu *et al.*, 2011). Knowledge of farm practice is acquired by farmers through experimentation and experience and passed on and improved from generation to generation (Morales and Perfecto, 2000).

Farmers have devised and adopted various measures to improve their farm output over the years. Over the last ten years, the commendable appreciations of eggplant production have certainly come with enormous farmers' input. Farmers' observations on the farms have been critical to disease identification and the development of management strategies. Therefore, their involvement in diseases identification has been advocated strongly in stakeholder-inclusive disease management programmes to ensure high adoption of methods that will be developed eventually.

Farmers' appreciation of pests and diseases may vary in different locations or agroecologies (Van Huis and Meerman, 1997). Wilt disease symptoms are associated with a number of biotic and abiotic causes. Prevailing conditions of a location influence the perception of farmers about a wilt disease. Accurate recognition of wilt disease is a challenge for many farmers. Farmers easily adopt peer knowledge or available management techniques for managing disease; inaccurate disease recognition may, therefore, result in ineffective disease management (Abudulai *et al.,* 2006).

Addressing challenges in eggplant production in Ghana is necessary to safeguard the economic gains in its value chain. An integrated approach to disease management is encouraged amongst farmers in Ghana. However, adoption and investments in disease management methods by farmers depend on among other factors, the appreciation of farmers of the disease. In this study, some major eggplant growing areas in the Ashanti, Eastern and Volta Regions were surveyed to determine farmers' socio-demographic characteristics, farming history, awareness and perception of Fusarium wilt disease of eggplants.

MATERIALS AND METHODS

Study Areas

The study was conducted in the Ashanti, Eastern and Volta Regions of Ghana from 2017 to 2019. These regions were selected due to the high production of eggplants in these areas. In Ghana, about 55092 tons of eggplants are produced annually on an estimated 6295 Ha of land, mostly in the Ashanti and Eastern Regions (FAOSTAT, 2019). Five eggplant-producing communities were selected from each region through purposive sampling. Offinso, Abofour, Juaso, Nsuta, and Besro were selected in the Ashanti Region, in the Eastern, Kwahu Praso, Enyerisi, Nkurakan, Huhunya, Asiakwa were selected and in the Volta Regions Have, Tafi, Vakpo, Aneta and Yordan communities were selected. All the areas under study have warm and humid equatorial climate with bimodal rainfall patterns. Major rains

span from March to July, and minor rains span from September to November each year. Agriculture is the main livelihood of the people.

Sampling Methods

In collaboration with the district agricultural officers, agricultural extension agents and key informant farmers or farmer heads in the eggplant growing communities, eggplant farmers were selected for the eggplant Fusarium wilt disease awareness survey. Fifty (50) farmers were purposively selected using the snowball method from each of the fifteen (15) communities sampled in the Ashanti, Eastern and Volta Regions. Two hundred and fifty (250) farmers were interviewed in each region, and a total of seven hundred and fifty (750) farmers were interviewed in the study.

Questionnaire Administration

The sampled farmers were individually interviewed using a questionnaire (Appendix 1) and coloured pictorial illustration of the Fusarium wilt of eggplant. The questionnaire was used to obtain information on the socio-demographic characteristics of the eggplant farmers and their knowledge and perceptions of the Fusarium wilt of eggplant. Socio-demographic information inquired included the age, gender, and educational level of respondents. Information on knowledge of the Fusarium wilt of eggplant inquired whether the farmer had observed Fusarium wilt of eggplant in their farm, disease symptoms, and part of crop affected, at what growth stage is initial symptom observed. Questions about the perception of Fusarium wilt of eggplant were based on the mode of spread of the disease and its control, distribution of wilt in farms, frequency of wilt occurrence on farms, losses due to the disease, and ranking of wilt in terms of importance in relation to other eggplant diseases encountered. Other questions included cropping system practised crops cultivated, source of eggplant seeds, eggplant species or varieties cultivated.

Data Collection and Analysis

Quantitative data collected were coded and subjected to descriptive statistics consisting of frequencies and percentages using the Statistical Package for Social Science (SPSS) Version 16.0 for Windows (SPSS Inc. 2007). The Duncan's multiple range test was used to separate the differences between means at a 5% level of significance. The results were presented as tables and graphs and interpreted appropriately.

RESULTS

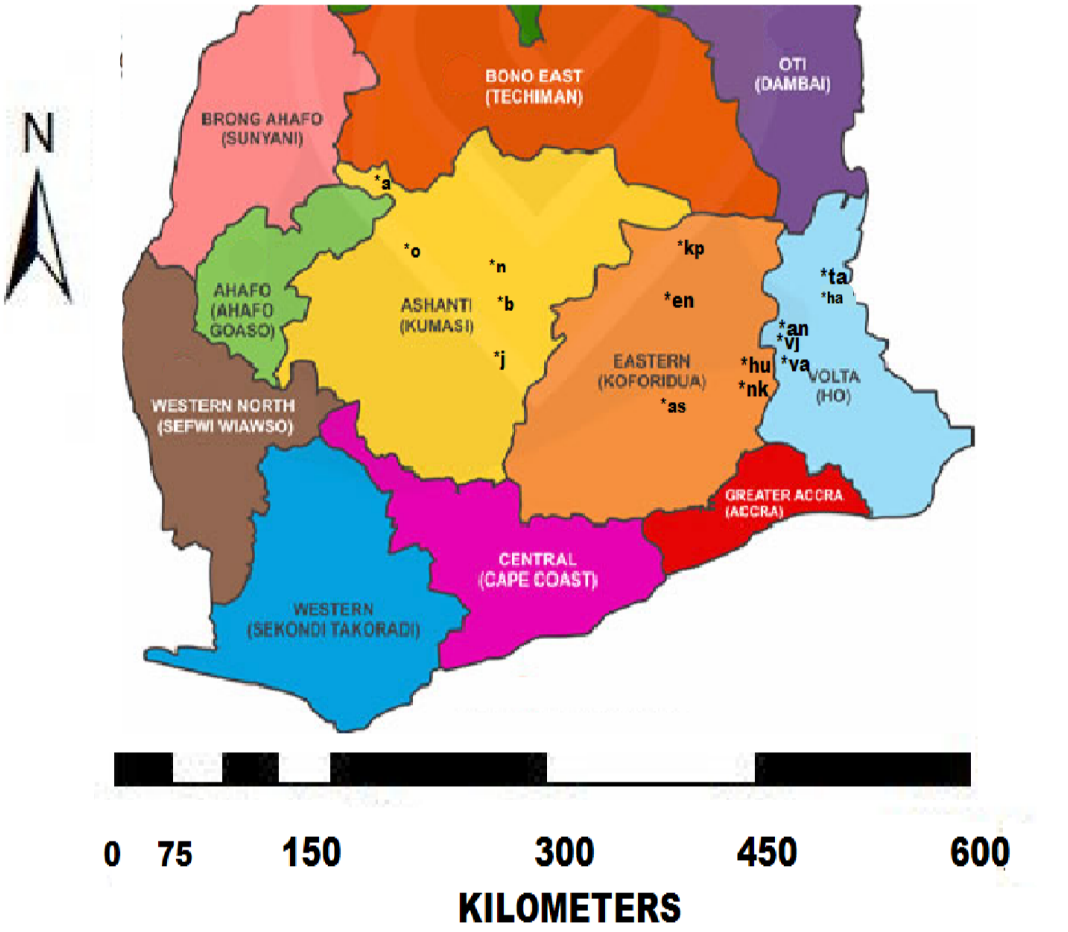

Plate 1: Map Indicating the Surveyed Communities in the Ashanti, Eastern and Volta Regions of Ghana

Socio-demographic Characteristics of the Farmers

A total of seven hundred and fifty (750) respondents were interviewed in the three selected regions for socio-demographic characters; two hundred and fifty (250) respondents were selected for each region. The male to female ratio of the respondents in the regions combined was approximately 2.4: 1. The male to female ratio was widest in the Eastern region and narrowest in the Volta region. Most farmers were between the ages of forty (40) years and forty-nine (49) years. However, age brackets from mid-twenties to mid-fifties were fairly represented in the respondents. Most of the farmers had some form of formal education. Twenty-four percent (24%) of the farmers had secondary or tertiary education. Thirty-eight percent (38%) of them had formal education to the primary level, and about thirty-seven per cent (37%) had no formal education at all. The summary of the socio-demographic characteristics of the respondents is in Table 1.

Table 1: ***Summary of the Socio-Demographic Characteristics of Respondents in the Ashanti, Eastern and Volta Regions***

Variables	**Numbers of Farmers**				
Gender	**Ashanti**	**Eastern**	**Volta**	**Total**	**Percent-age**
Female	70	58	90	218	29.07
Male	180	192	160	532	70.93
Total				**750**	
Age(years)					
under 30	30	33	32	95	12.67
30-39	61	69	69	199	26.53
40-49	89	94	98	281	37.47
50 and over	70	54	51	175	23.33
Total				**750**	
Education					
Primary	107	109	71	287	38.27
Secondary School	34	30	69	133	17.73
Tertiary	8	18	27	53	7.07
No formal education	101	93	83	277	36.93
Total				**750**	

Farming History of the Respondents

Information on the farming history of the respondents was inquired to ascertain the respondents' farming experience and farm characteristics. Two hundred and fifty (250) respondents were interviewed for each of the three selected regions. Most of the respondents, representing 56.8% (426), had cultivated eggplant for over ten (years). The farm was started on land that had fallowed for some time, according to 61.2% (459) of the respondents, whilst 38.8% (291) of the respondents started farming on non-fallowed land. The farm sizes of respondents were mostly below three (3) acres, but a substantial number of respondents, 47.87% (359), had farm sizes above three (3) acres. Eggplant "varieties" Kpando and Dwomoh were cultivated by 70.53% (509) of the respondents. The Kpando variety was the most cultivated. Some of the respondents, 20.4% (153), referred to the variety cultivated by their local language, thus, "nyaadoa" in the Ashanti region and "ntrowa" in parts of the Eastern region. Sixty-eight of the respondents, representing 9.07% of the total respondents, however, referred to their eggplant as a foreign variety. Most of the eggplant seeds used for cultivation were farmer-saved seeds. Seeds were also obtained from other farmers and the vegetable market. Only 46 (6.53%) of the respondents obtain seeds from Agro-input shops. The yield of eggplant per acre of land was generally above five (5) tonnes. Three hundred and fifty-nine (47.87%) of respondents realise a yield of above ten (10) tonnes per acre, whilst 104 (13.87%) of the respondents reported a yield of below five (5) tonnes per acre. The summary of the farming history of the respondents is presented in Table 2.

Table 2: Farming history of the respondents in the Ashanti, Eastern and Volta Regions of Ghana

	Number of Farmers				
Previous land use	**Ashanti**	**Eastern**	**Volta**	**Total**	**Percentage**
Cultivated	92	78	121	**291**	**38.80**
Fallow	158	172	129	**459**	**61.20**
Total				**750**	
Farm size					
Below 1 ha	163	89	139	**391**	**52.13**
Below 2 ha	66	111	68	**245**	**32.67**
Above 2 ha	21	50	43	**114**	**15.20**
Total				**750**	
Eggplant variety cultivated					
Dwomoh	125	119	0	**244**	**32.53**
Kpando	0	35	250	**285**	**38.00**
Foreign	35	33	0	**68**	**9.07**
Unknown	90	63	0	**153**	**20.40**
Total				**750**	

Seed source					
Farmer-saved seeds	115	141	182	**438**	**58.40**
Other farmers	55	45	36	**136**	**18.13**
Agro-input shops	23	26	0	**49**	**6.53**
Vegetable market	58	38b	31	**127**	**16.93**
Total				**750**	
Yield (tonnes per hectare)					
Up to 12	35	37c	32	**104**	**13.87**
12-25	128	56	103	**287**	**38.27**
Above 25	87	157	115	**359**	**47.87**
Total				**750**	
Years of eggplant farming					
below 5	49	54	44	**147**	**19.60**
5-10	77	50	50	**177**	**23.60**
above 10	124	146	156	**426**	**56.80**
Total				**750**	

Farming Practice of Respondents

The slash and burn method were the main land preparation method reported by respondents in the study areas, especially in the Ashanti and Eastern regions. Herbicides were used considerably in all the study areas for weed control. Ploughing was largely used in the Volta region for land preparation. Farms that were ploughed in the Ashanti and Eastern regions were few. Over fifty per cent (57.73%) of the respondents cultivated eggplant as a mono-crop. Crops mixed with eggplant in a mixed cropping system included pepper, okra, and tomato. Mixed cropping eggplant with tomato was, however, practiced by a few respondents. Rotating eggplant and maize were commonly practiced by respondents in the Volta region, where eggplants were usually cultivated in the major rainy season and maize in the minor season. Other rotational crops used by the respondents included pepper, okra, and tomato. Rice was used as a rotational crop by a few respondents who farm rice in swampy areas. The summary of the farming practices of the respondents is presented in Table 3.

Table 3: Farming Practice of the Respondents in the Ashanti, Eastern and Volta Regions of Ghana

	Number of Farmers				
Land preparation	**Ashanti**	**Eastern**	**Volta**	**Total**	**Percentage**
Slash and burn	137	118	91	**346**	**46.13**
Herbicide application	88	83	53	**224**	**29.87**
Ploughing	25	49	106	**180**	**24.00**
Total				**750**	
Cropping system					
Mono	124	151	158	**433**	**57.73**
Mixed	126	99	92	**317**	**42.27**
Total				**750**	
Intercrop					
Pepper	70	67	47	**184**	**58.04**
Tomato	17	8	0	**25**	**7.89**
Okra	37	24	47	**108**	**34.07**
Total				**317**	
Land use					
Crop rotation	194	158	231	**583**	**77.73**
Same crop	56	92	19	**167**	**22.27**
Total				**750**	
Rotation crop					
Pepper	68	60	57	**185**	**31.73**
Tomato	51	21	6	**78**	**13.38**
Maize	45	63	127	**235**	**40.31**
Rice	9	0	3	**5**	**0.86**
Okra	13	25	42	**80**	**13.72**
Total				**583**	

Farmers' Knowledge of Fusarium Wilt of Eggplant

Farmers that could identify Fusarium wilt disease symptoms of eggplant amounted to 88.8% of the total 750 respondents interviewed. About 90% of the farmers reported having observed the symptoms in their farms. They responded that symptoms could be observed at any stage of the crop development but were more noticeable when the crop began to fruit. Considerable numbers of respondents were unaware of the cause of the disease. The farmers who knew the cause of the disease were the minority, and they mainly attributed the disease to the plant root. Fusarium wilt diseases of eggplant were considered a slow killer by most of the farmers. However, some thought the disease kills quickly, whilst others had not taken notice of the rate of disease progression. The percentage of disease incidence below 10% was reported by 56.95% of the total respondents interviewed. There were higher incidences of the disease in the Eastern and Volta regions than in the Ashanti regions.

The distribution of the disease on the farm was reported to be scattered or patchy by 80.4% (603) of the farmers. Farmers employed various methods to manage the disease. Rouging was the main disease management method used; however, fungicidal substances and land rotation were used by a considerable number of the farmers to manage the disease. Fusarium wilt diseases of eggplant were reported to occur with other diseases such as leaf blight, root-knot, stem canker, fruit rot, and, more especially, leaf spot. Figures 1-12 illustrate farmers' knowledge of Fusarium wilt disease of eggplant.

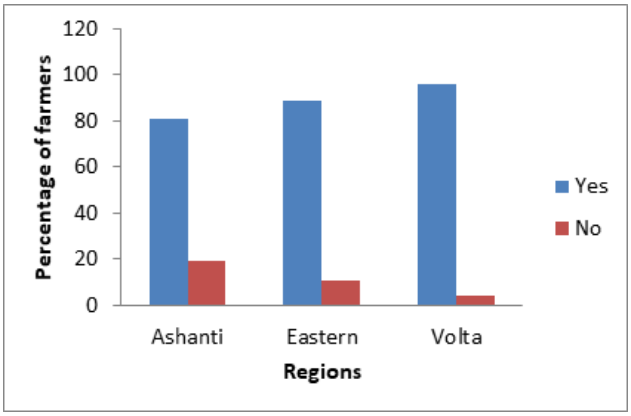

Fig. 1: Response on Whether or Not the Farmer Can Identify Fusarium wilt Symptom of Eggplant

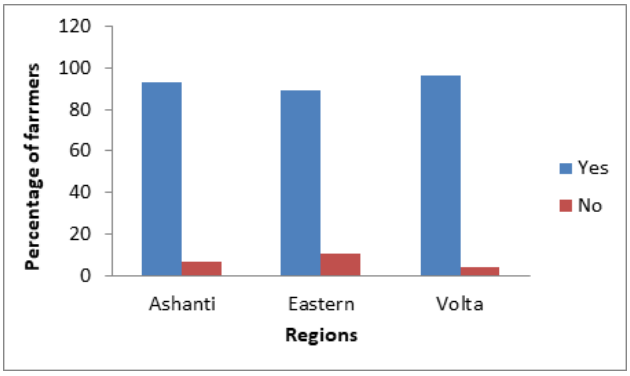

Fig. 2: Response on Whether or Not There is Incidence of Fusarium Wilt Symptom of Eggplant on Respondent's Farm Symptom

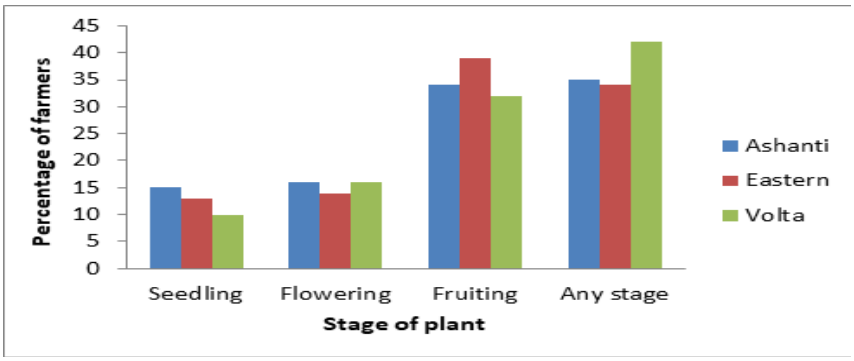

Fig. 3: Response on the Stage of Eggplant with Initial Fusarium Wilt

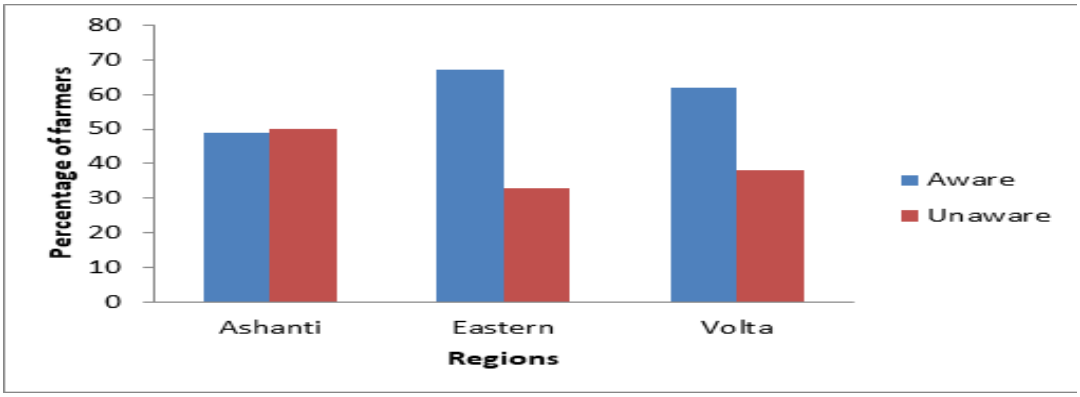

Fig. 4: Response on Whether or not the Respondent is Aware of the Cause of Fusarium Wilt of Eggplant.

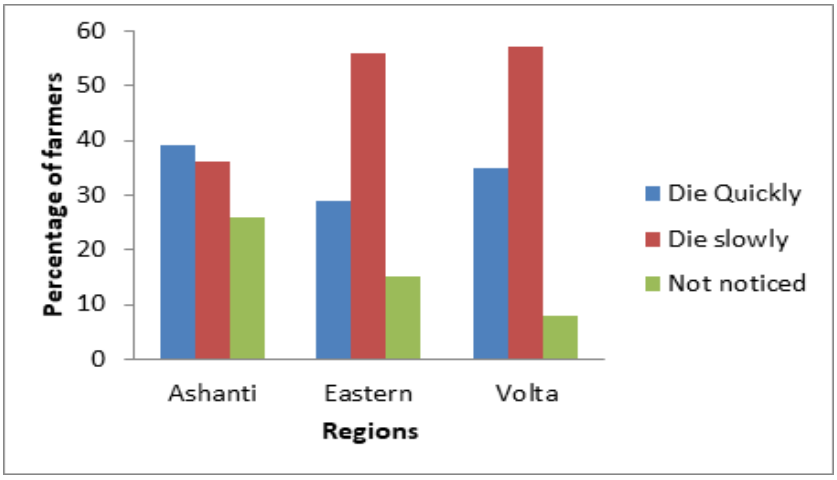

Fig. 5: Fusarium Wilt Disease Progression in Eggplants

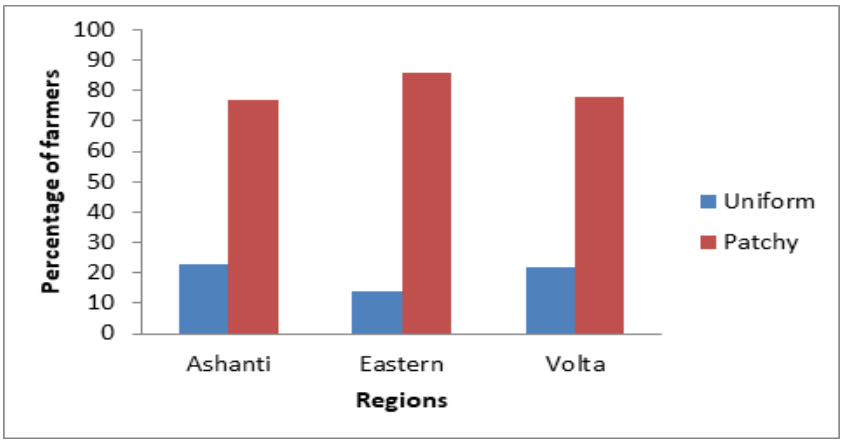

Fig. 6: Response to Disease Istribution Pattern

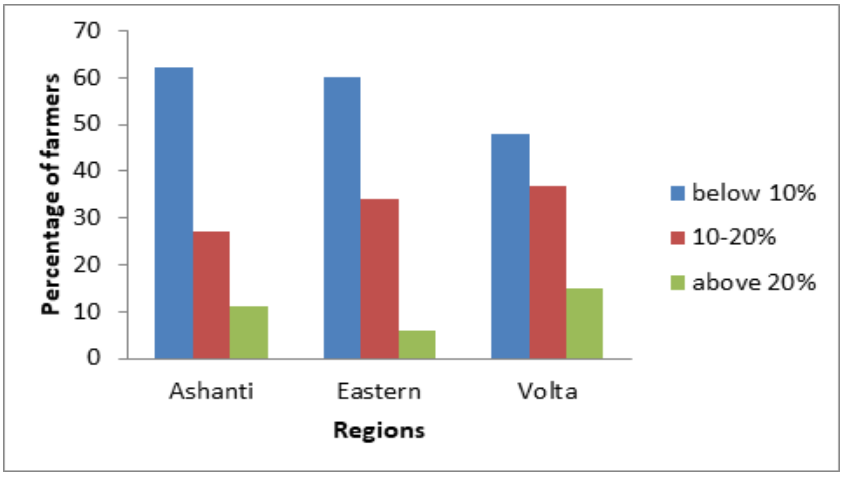

Fig. 7: Percent Incidences of Fusarium Wilt in the Respondent's Farm

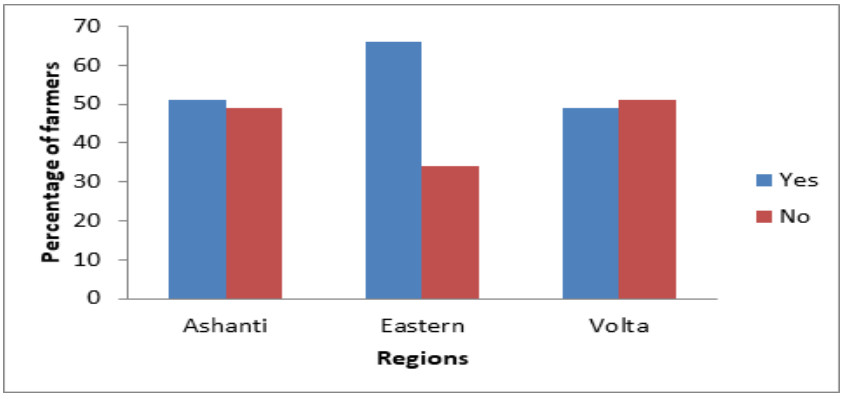

Fig. 8: Response on Whether or not there is Wilt Incidence on Other Crops in the Farms

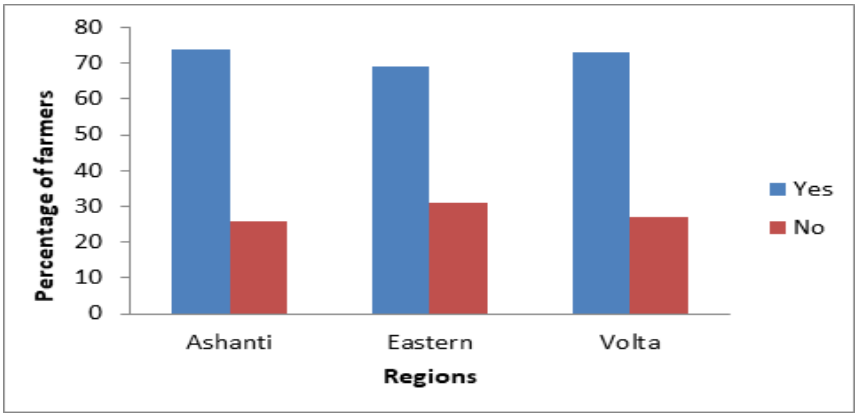

Fig. 9: Response on Whether Fusarium Wilt Disease is Managed in the Farms

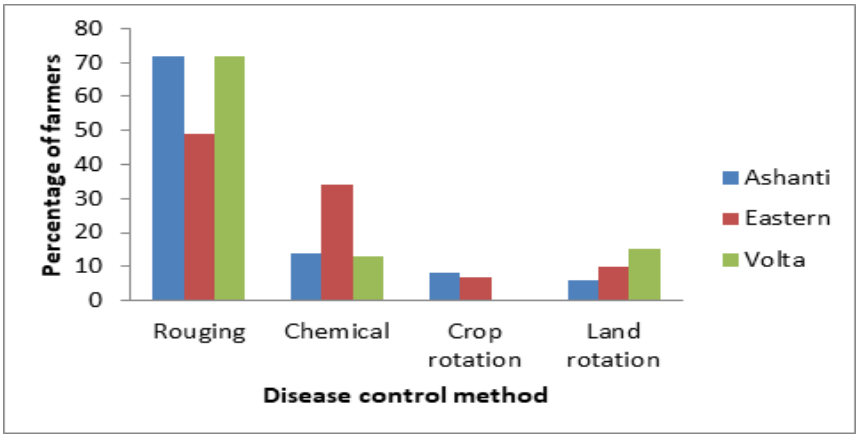

Fig. 10: Fusarium Wilt Disease Management Method Used by Farmers

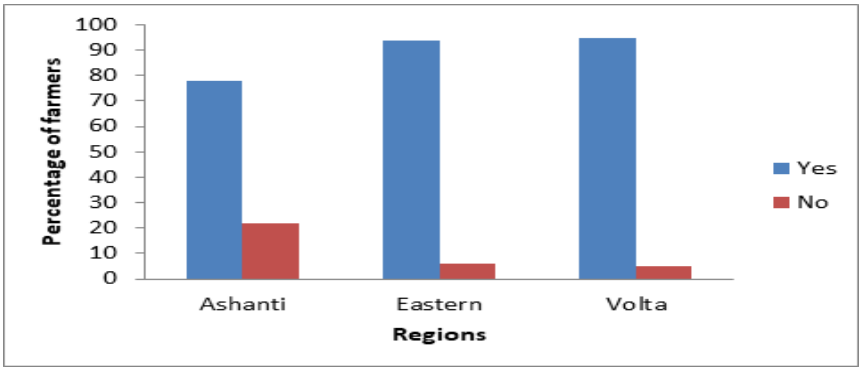

Fig. 11: Response on Whether Fusarium Wilt Disease Occurs with Other Diseases on Eggplant on the Farm

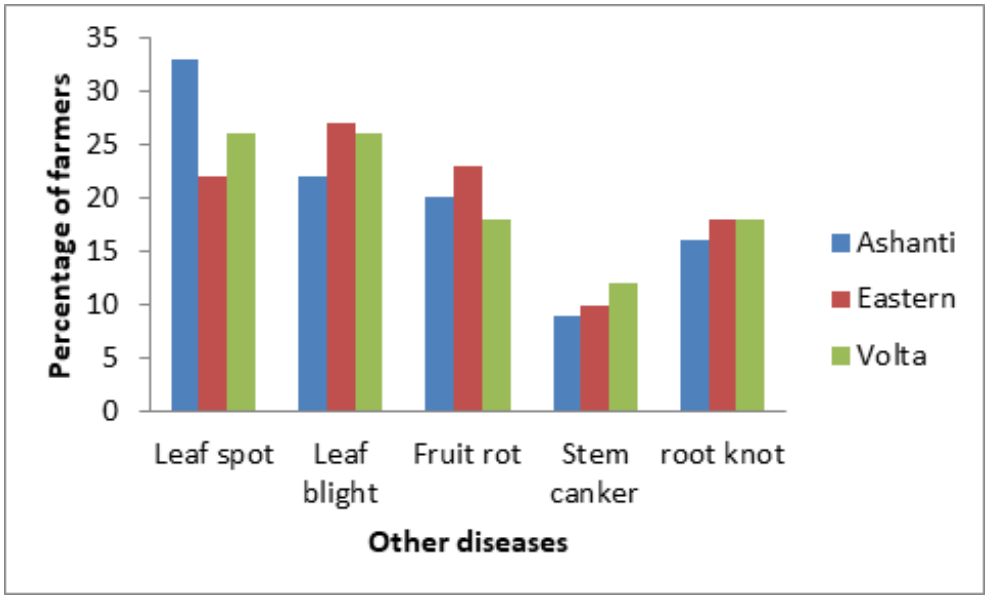

Fig. 12: Response on Diseases of Importance that occur with Fusarium Wilt on Eggplant on the Farm

Perceptions of Farmers on Fusarium Wilt of Eggplant

Most of the farmers strongly agreed or agreed that the Fusarium wilt disease of eggplant caused a major yield loss. Those who applied a management measure opined largely that their management approaches were inexpensive. However, some section of the farmers thought the disease was expensive to manage. According to most of the respondents, management of the disease did not yield the desired success; this was occasioned by the recurrence of the disease in previously managed areas. According to this study, the respondents that have had some education about Fusarium wilt disease of eggplant from an agency or individual almost equalled those that had not been educated purposively about the disease. Education about the disease was generally received from fellow farmers and sometimes, from agricultural extension agents. Other farmers accessed information about the disease from the media. Figures 13-17 illustrate respondents' perception of Fusarium wilt diseases of eggplant.

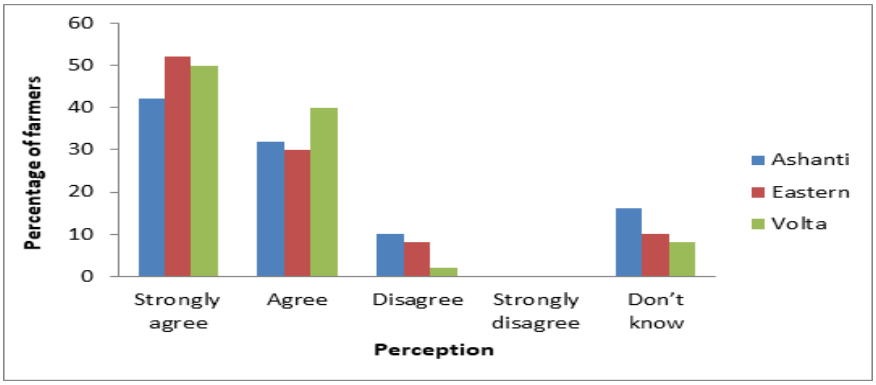

Fig. 13: Farmers' Perception That Fusarium Wilts Disease Causes Major Yield Loss in Eggplant

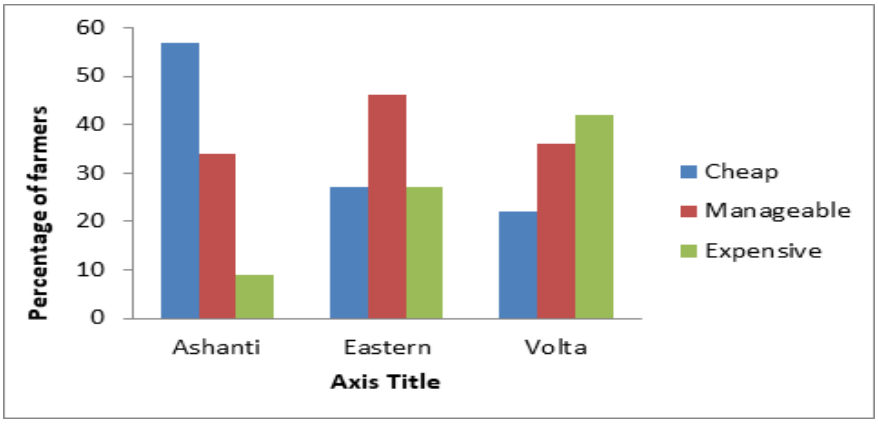

Fig. 14: Farmers' Perception on the Cost of Controlling Fusarium Wilts Disease of Eggplant

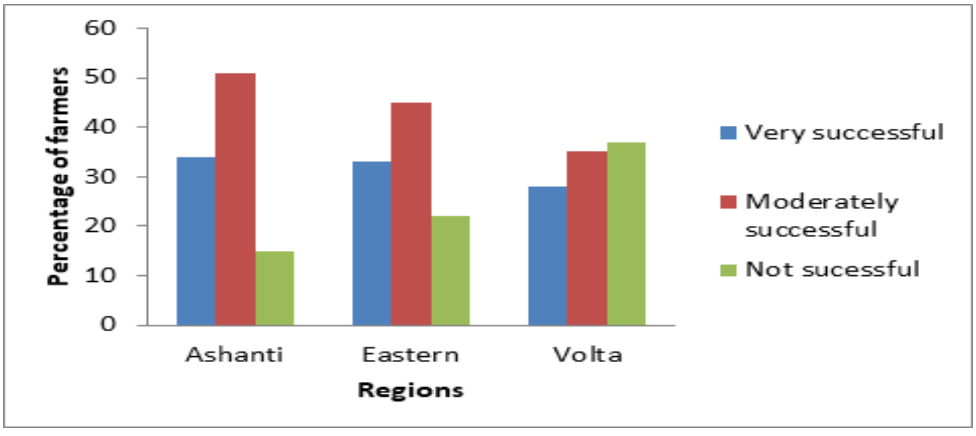

Fig. 15: Farmers' Perception on the Success of Managing Fusarium Wilts Disease of Eggplant

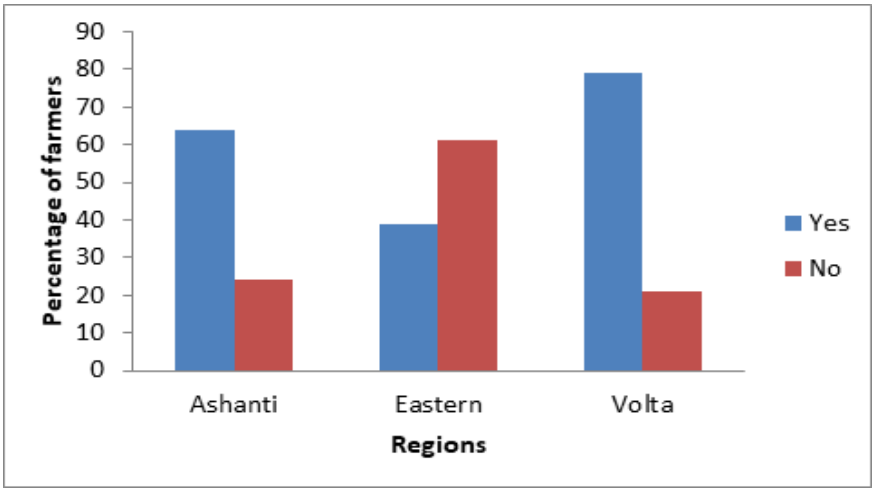

Fig. 16: Number of Farmers Who Have Had Education on Fusarium Wilts Disease of Eggplant

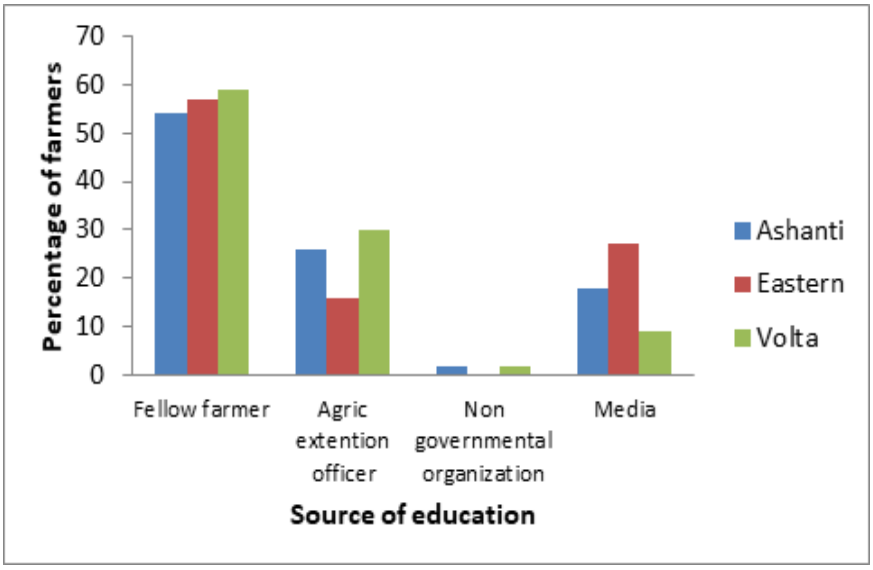

Fig. 17: Source of Education of Farmers on Fusarium Wilts Disease of Eggplant

DISCUSSIONS

Socio-demographic Characteristics of Farmers

The socio-demographic characteristics of farmers in the study areas were similar. Eggplant cultivation was observed to be male dominated. Observations made by Ozobia *et al.,* (2013) when they assessed eggplant production in Nigeria is like that of this study on gender participation in eggplant production. Capital intensiveness and high labour requirements may account for the male dominance in eggplant production. This attribution was also made by (Udoh and Etim, (2008) and Umoh, (2006).

The involvement of females in farming activities peaks during fruit harvest. Thus, most women in the eggplant value chain are hired labour for fruit harvest or produce sellers, with limited numbers being actual farm owners. However, women in rural Ghana make substantial income from eggplant (Danquah and Ofori, 2012) since they dominate in the value chain aside from production. Eggplant production in the three regions is fairly participated by farmers of an age group of 30 to 50 years. Ubokudom *et al.,* (2010) reported youthful age in eggplant production, noting that farmers older than fifty years preferred less labour-intensive crops such as root and tuber crops and tree crops. Generally, Ghanaian farmers are rural dwellers with limited or no formal education. This situation pertains to eggplant growers in this study, where only 24% of the farmers had secondary to tertiary education. Ozobia *et al.,* (2013) also observed that due to the profitability of eggplant farming, parents encouraged their children to farm instead of schooling in rural areas. Farming in the West Africa sub-region is restricted to illiterates and semi-literates, according to Djabletey and Adu-Bredu (2007).

Farming History of the Farmers

Eggplant is one of the annual crops in Ghana that farmers cultivate for a long time. Most of the farmers growing eggplant have over ten years of cropping experience. Farms were usually situated on fallowed land, which had recovered lost nutrients. This was the farmers' choice to minimise the use of agricultural inputs such as fertiliser and pesticides and increase profitability. Pest management and produce handling become problematic to many vegetable peasant farmers in Ghana during bumper harvest. This situation cautions farmers on farm size. Largely sampled stayed within 5 acres of land as farm size. Comparing farm efficiency between the small and large-scale farms of resource-poor farmers (Mkhabela, 2005; Ubokudom *et al.,.,* 2010) noted that farms that were below three acres of land were more efficient than those that were above as the major sources of farm labour were the family. Farm size below 5 acres was considered manageable by most eggplant farmers in this study.

No record of released eggplant variety in Ghana was found. However, two cultivars by the name 'Kpando' and 'Dwomo' were very popular amongst eggplant farmers. These cultivars were mostly cultivated because of their large fruit size and fruits' nice appeal. 'Kpando' was identified to tolerate some pests and diseases. Furthermore, these cultivars were stable. Thus, seeds from previous crops do not produce degenerate crops. Seed degeneration was the main reason why there was

limited use of foreign seeds or certified seed by eggplant farmers.

No official variety of eggplant was released for cultivation, a study by (Owusu-Ansah *et al.,*., 2001; Horna *et al.,,* 2007) revealed. However, farmers cultivate several local varieties to meet the domestic demand (Owusu-Ansah *et al.,,* 2001). The University of Ghana, Legon and the Crop Research Institute of the Council for Scientific and Industrial Research have been working on improved lines but have since not officially released variety to farmers (Horna *et al.,,* 2007). Farmers preferred the use of farmer-saved seeds because of the reliability and availability of the seeds and economic reasons. They were unable to save seeds relied on other farmers for seeds or purchased eggplant fruits from the market for seed extraction. Production of eggplant is considered a lucrative venture by farmers. Most farms realise over five tonnes of produce per acre of land. Revenue from the produce is dependent on scarcity of the produce and, therefore, fluctuates within the year.

Farming Practice of the Farmers

Manual means of land preparation is predominant amongst peasant farmers in Ghana. Small farm sizes, sloppy land topography, and the peasant farmers' economic status were the compelling factors. This practice was often augmented with the application of chemicals with herbicidal or weedicidal properties. Ploughing is encouraged on large farms that have flat and even land topography, as in the case of the communities sampled in the Volta region of Ghana. Farmer associations engaged tractor services to plough many small farms that were not far apart; this collective arrangement enabled resource-poor peasant farmers in the Volta region to access tractor services. Mono-cropping was practiced for considerable large-scale farming purposes for income generation. The mono-cropping allowed for uniform agronomic practice, harvesting and post-harvest activities. Mixed cropping was also practiced where the eggplant was the dominant crop interspersed with other vegetable crops such as okra and pepper. Crop rotation activities in the bimodal rainfall areas such as the Ashanti, Eastern and Volta regions of Ghana, where two crops are cultivated yearly, are often governed by the rotating crops' water demand. Crops with higher water demand are cultivated during the major rainy season, whereas less water-demanding crops are cultivated in the minor rainy season. In areas where the same crop is cultivated in the two seasons of the year, especially for the water-demanding crops, irrigation facilities are used in the minor season; otherwise, crop failure due to water unavailability is imminent. The minor rain season offers limited disease spread; therefore, disease-vulnerable crops such as vegetables are cultivated during the minor rainy season.

Knowledge of Farmers on Fusarium Wilt of Eggplant

Farmer experience was an essential factor in symptom identification and recognition of Fusarium wilt diseases of eggplant. The wilt symptoms that farmers in Fusarium infected eggplant most noticed were superficial and inadequate for diagnosis. Other symptoms, such as the pattern of wilt on leaves, symptom of disease progression, and distribution

of disease on the farm, refines disease description. A more clinical symptom of Fusarium wilt diseases of eggplant are root xylem collapse or distortion and inner pigmentation of root and shoot tissues; these histologic symptoms, together with the isolation of *Fusarium* species from infected tissues, would confirm the disease. Acknowledgement of symptoms of Fusarium wilt disease by a large majority of farmers indicated the importance of the disease amongst the farmers and was reflective of farmers' long experience in eggplant cultivation. Fusarium wilt disease, like many wilt diseases, is stress-induced and can manifest at any stage of crop development. The flowering stage of vegetable crops through to the fruiting stage marks the peak of crop development where the crop is burdened with high nutrient demand and high metabolic rate. These conditions stress the crop and expose the crops to wilt diseases (Nogués *et al.,*., 2002). The situation can be exacerbated by harsh environmental conditions (Okungbowa and Shittu, 2011). Stress conditions and pathogen virulence can influence the progression of wilt disease on crops. Fusarium wilt disease of eggplant can vary over places and within different cultivars. Thus, farmers' assessment of the rate of decline of Fusarium wilt-infected eggplants complied with the general observation (AVRDC, 2005).

Fusarium wilt disease is widespread in cultivated lands globally. However, percent incidence of the disease in a particular place is dependent on many factors, among which but not limited to previous vegetation, continuous cultivation of host crops on the same land, poor farm sanitation, and crop rotation with other host crops. Similar rotational and mixed crops in the eggplant agro-system in the Ashanti, Eastern and Volta regions may have accounted for the similarity in the incidence of Fusarium wilt disease of eggplant. Moreover, most of the eggplant seeds used for cultivation are farmer-served, or farmer-shared seeds, which indicate limited genetic variability among the cultivars. Pattern of symptom distribution of biotic diseases, especially, monocyclic diseases like Fusarium wilt, is patchy or uneven. A large majority of the farmers attested to uneven symptom distribution of Fusarium wilt disease of eggplant.

Root-knot, stem canker, fruit rot, leaf blight and leaf spot are common disease symptoms associated with eggplant. Mixed infection is a common phenomenon with infectious diseases. Different diseases with different infectious cults and a common host can co-exist. Mixed infection may result in a quicker decline in host plants. The high incidence of root-knot disease in the eggplant growing areas of the Eastern and Volta regions of Ghana is worrying because of the synergistic relation of root-knot disease and Fusarium wilt disease when they are mixed with infected eggplant (Morrell and Bloom, 1981). Stem canker and fruit rot disease cause crop failure and blemish on produce. Leaf blight and leaf spot are known to reduce photosynthetic leaf area (Nogués *et al.,,* 2002), a condition that causes growth retardation, diminished fruit sizes, and cause death to many vegetable crops, including eggplants.

Perceptions of Farmers on Fusarium Wilt of Eggplant

Long-term association of farmers with a particular disease or situation could result in a common assessment of the disease. The assertion of high yield loss caused by Fusarium wilt disease of eggplants by most farmers in the eggplant growing areas sampled is a result of stunted growth and leaf yellowing, which is characteristic of Fusarium wilt disease of eggplant. Land rotation, crop rotation and rouging infected crops methods used by the farmers for the management of Fusarium wilt disease of eggplant are largely cultural and inexpensive; however, these methods could not yield the desired results as the disease reoccurred. Cultural management methods, at best, slow down the build-up of pathogen innoculi for Fusarium wilt diseases.

According to this study, the most readily available source of education for the farmers was a fellow farmer, reiterating that farmer associations are effective means of information dissemination amongst farmers. The mass media, which is far-reaching, could augment efforts of the agricultural extension officers in educating farmers about the Fusarium wilt disease of eggplant.

CONCLUSIONS

This study reveals similar socio-demographic characteristics among eggplant farmers in the Ashanti, Eastern and Volta Regions of Ghana. Eggplant production in the three regions is largely the occupation of farmers between the ages of 30 and 50 years, with about 63% of them having some form of formal education.

Males dominated in the cultivation of eggplant. However, females played a major role during fruit harvest and marketing.

Labour intensiveness, labour cost, agricultural inputs, and postharvest management were the main reasons most eggplant farmers cultivated less than five acres of land.

Farmers in the surveyed areas were aware of the symptoms of Fusarium wilt disease of eggplant; however, they were oblivious of the cause and source of the disease and, therefore, were unable to apply appropriate methods to manage the disease.

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