Journal of Agriculture and Ecology Research International
6(3): 1-9, 2016; Article no.JAERI.23012
ISSN: 2394-1073

SCIENCEDOMAIN *international*
www.sciencedomain.org

Production Practices and Pest and Disease Problems of Tomato Farmers in Ashanti Region of Ghana

F. J. Manneh[1,2], C. K. Kwoseh[1*] and J. L. Starr[3]

[1]Department of Crop and Soil Sciences, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
[2]National Agricultural Research Institute (NARI), Banjul, The Gambia.
[3]Department of Plant Pathology and Microbiology, Texas A&M University, College Station, TX 77843-2132, Texas, USA.

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAERI/2016/23012
Editor(s):
(1) Mirza Hasanuzzaman, Department of Agronomy, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Bangladesh.
(2) Daniele De Wrachien, Department of Agricultural and Environmental Sciences of the State University of Milan, Italy.
Reviewers:
(1) K. M. Pofu, University of Limpopo, South Africa.
(2) Mahmoud M. A. Youssef, National Research Centre, Egypt.
Complete Peer review History: http://sciencedomain.org/review-history/13132

Original Research Article

Received 10th November 2015
Accepted 29th December 2015
Published 30th January 2016

ABSTRACT

Aims: The main objective of the study was to identify the tomato production system, associated pest and disease problems and their management by tomato farmers in Ashanti Region.
Design of the Study: A questionnaire-based survey was conducted.
Study Place and Duration: The study was carried out at Akumadan, Agogo, Sabronum, Afari, Kofiase and Kumawu between March and May, 2015.
Methodology: Multistage sampling technique was used to select the respondents. A total of 120 respondents from six different sites were randomly selected from tomato farmers in the surveyed areas in Ashanti Region. Data collected were analyzed using Statistical Package for Social Science (SPSS).

**Corresponding author: E-mail: ckwoseh@hotmail.com;*

Results: The tomato var. Power was found to be the most cultivated by the farmers. Majority of farmers cropped on farm sizes from 1.6 to 2.0ha. Tomato cultivation was done in March and September on ridges. All the respondents applied fertilizer to improve soil fertility. The major pests and diseases outlined by the respondents were: root-knot nematodes, fruit borers (caterpillars), whiteflies, damping-off, wilting and leaf curl. Majority of the respondents mentioned nematodes infestation (30%) as their major constraint followed by caterpillars (25%) and then whiteflies damage (20%). Also, the respondents observed fungal diseases such as damping-off and wilt (10%) and leaf curl (10%). All the respondents used either insecticides alone (5%) or combination of insecticides and fungicides (95%). None of the respondents used nematicides as control method, however, all of them used crop rotation and weeding as pest and disease management options in addition to pesticides. One hundred percent (100%) of the respondents said that insecticides and fungicides used were effective against insect pests and fungi, respectively. However, majority of the respondents (85%) stated that the used control strategies against root-knot nematodes were not effective.

Conclusion: Majority of respondents, in the surveyed sites, mentioned root-knot nematodes as their main pest problem to tomato production, followed by insect pests and fungi. The respondents used mainly insecticides and fungicides or a mixture of them to control insect pests and diseases. In addition, other management practices such as crop rotation and weeding were used. No nematicides were used by the respondents. Majority of the respondents considered management practices (crop rotation and weeding) against nematodes as ineffective methods. However, all the respondents considered use of insecticides and fungicides as an effective method against insect pests and fungal diseases, respectively. The study recommended training of tomato farmers on crop rotation systems that may be effective in reducing pests and diseases on tomato. Also, tomato farmers should be trained on pesticide usage, its safety and disposal.

Keywords: Tomato; pesticides; pests; diseases; production.

1. INTRODUCTION

Tomato, (*Solanum lycopersicum* L.) is one of the important vegetables commonly grown by smallholder farmers in Ghana [1]. The daily consumption of tomato in the form of paste, sauce and ketch-up is higher than other vegetables [2]. It is rich in nutrients such as vitamins and minerals which are important to well-balanced human diets. It is also an essential dietary component because it contains high level of lycopene, an antioxidant that reduces the risks related to several cancer diseases [3].

The government of Ghana is encouraging the development of the tomato industry in order to diversify the country's export base [4]. However, yields obtained by farmers are far below the potential. Twenty years ago, the average yield of tomato was estimated at 13.5T/ha [5] and in 2010 it was estimated at 7.5T/ha [6]. This has created a yield gap of about 50%. One of the main constraints associated with the low yield are the problem of pests and diseases [7]. Similarly, Anang et al. [8] attributed the low yield of tomato at farmers' fields mainly to the high incidence of insect pests and diseases.

Previous survey carried out in the Savanna and Forest-Savanna Transitional zones by Adu-Dapaah and Oppong-Konadu [9] observed that foliar and soil-borne diseases such as damping-off, blight, Fusarium wilt and Tomato Mosaic Virus were the most economically important on tomato in Ashanti Region. Similar study by Asare-Bediako and Micah [10] found insect pests such as caterpillars and whitefly to be most economically important on tomato in Ghana. In furtherance to these pests and disease problems, the current study looked at other soilborne pathogen such as root-knot nematodes and their management strategies. Therefore, it was necessary to ascertain farmers' tomato production system in Ashanti Region, and identify pests and diseases constraints and their management strategies.

2. METHODOLOGY

Ashanti Region of Ghana lies between longitudes 0.15W and 2.25W, and latitudes 5.50N and 7.46N. The region shares boundaries with Brong-Ahafo Region in the North, Eastern Region in the East, Central Region in the South and Western Region in the South West. It covers a land area of 24,389 square kilometers representing 10.2% of the total land area of the country [11].

The region has bimodal rainfall pattern, with highest rainfall in May/June and October for the major and minor seasons, respectively. Mean annual rainfall is between 1100 and 1800 mm. The average annual temperature is 25.5°C in the southern parts of the region and 32°C in the northern part. The mean yearly humidity is about 85% in the southern parts of the region and 65% in the northern part [12]. The vegetation cover is moist Semi-deciduous Forest in the southern part of the region, whilst the Guinea Savanna occupies the northern part, which consists of short deciduous and fire resistant trees. Also, riverine forests occur along the Afram River and streams of the Savanna zone [11].

Soils in Ashanti Region are mainly Acrisols. Tomato production is an important farming activity in the region [13].

2.1 Data Collection and Analysis

The survey was conducted in March, 2015. Multistage sampling technique was used to select the farmers. The study started with purposive selection of the surveyed sites in consultation with the Ministry of Food and Agriculture in the region. A total of six sites, namely Akumadan, Agogo, Sabronum, Kumawu, Afari and Kofiase (Fig. 1) were selected. In the second stage of sampling, the names of tomato farmers were listed in the households. Twenty tomato farmers were randomly selected from each site using lottery method. Farmers were interviewed individually using both close-and open-ended questionnaires. A detailed information on crop production practices, pests and diseases and their management strategies were collected. The data were analyzed using Statistical Package for Social Science (SPSS) for Windows. Descriptive statistics were used and means were presented using tables and graphs.

3. RESULTS

3.1 Production Practices

The tomato varieties cultivated by the respondents were: Power, Pectomech, Pectofake, Akoma and Rhino. Power was found to be the most popular variety with 40% of the respondents cultivating it, followed by Pectomech and Pectofake with 20% each. Land area used by respondents for tomato cultivation in the surveyed sites varied from 0.2 to 6ha. Higher percentage (72%) of the respondents had farm sizes ranging from 1.6 to 2.0ha. Majority of the respondents (85%) cultivated tomato in March/April in the major season, while in the minor season most of the respondents (90%) cultivated in September (Table 1). In the case of soil preparation, all the respondents planted tomato on ridges.

All the respondents mentioned that they applied fertilizer to increase the fertility of the soil (Table 1).

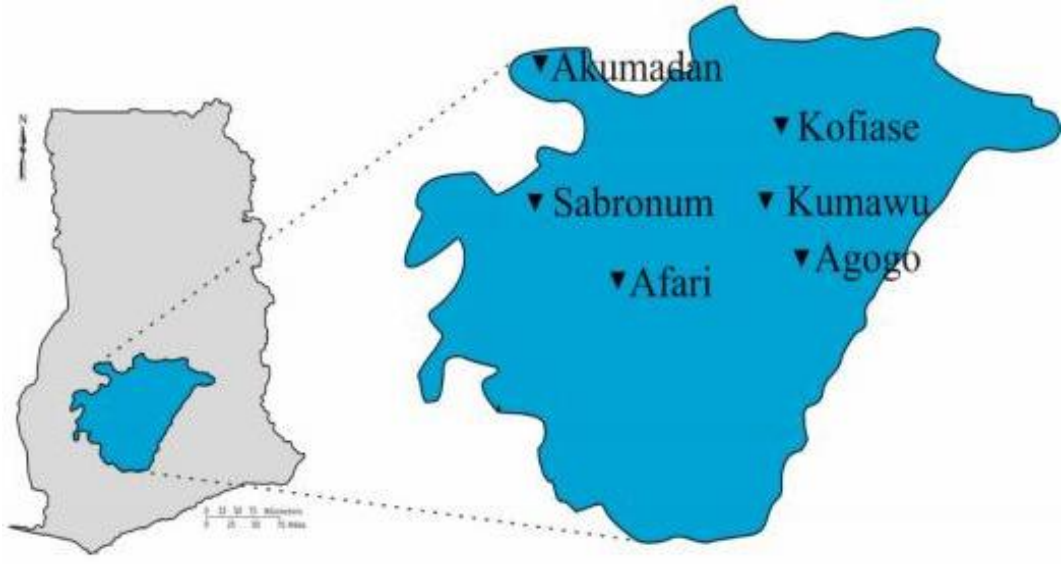

Fig. 1. Study sites in Ashanti Region of Ghana

Seventy percent (70%) of the respondents applied NPK and ammonium sulphate ($(NH_4)_2SO_4$) fertilizers followed by NPK and urea (15%), and then NPK and Sidalco NPK foliar fertilizer (10%). About 5% of the respondents applied NPK alone. Majority of the respondents (70%) used two bags (50 kg each) of NPK and one bag (50 kg each) of $(NH_4)_2SO_4$ per hectare, while 25 and 5% of the respondents applied three bags of NPK and one bag of $(NH_4)_2SO_4$, and one bag of NPK and half a bag of $(NH_4)_2SO_4$ per hectare, respectively (Table 1).

3.2 Pests and Diseases Associated with Tomato Production in the Ashanti Region

The pests and diseases outlined by the respondents in the survey were: root-knot nematodes, fruit borers, whiteflies, mites, damping-off, wilting and leaf-curl (Table 2).

Most of the respondents (30%) mentioned root-knot nematodes as the major pest affecting tomato, followed by fruit borers (25%), whiteflies (20%) and mites (5%). Damping-off and wilting (10%) and leaf curl (10%) were also observed by the respondents as fungal and viral disease problems in tomato cultivation (Table 2).

3.3 Management Practices Carried Out by Respondents

For the management of tomato pests and diseases, the respondents indicated the use of either insecticides and fungicides as combined or insecticides alone. Ninety-five percent (95%) of the respondents applied insecticide and fungicide as mixture, while 5% used insecticides alone to control pests and diseases. None of the respondents used nematicide or fungicide alone to control pests and diseases (Table 3).

Apart from application of synthetic pesticides, farmers used management methods such as crop rotation and weeding. All the respondents reported that they practiced crop rotation and weeding to also control pests and diseases. None of the respondents applied plant extracts or organic amendments as pests and diseases control strategy (Table 3).

Table 1. Production practices carried out by tomato farmers in the surveyed area

Activity	Frequency					Total
	Percent respondents					
Tomato variety grown	Power	Pectomech	Pectofake	Akoma	Rhino	
	40	20	20	10	10	**100**
Land Area cultivated to tomato	0.2 – 0.4ha	0.8-1.2ha	1.6-2.0ha	2.4-2.8ha	3.2-3.6ha	
	2	20	72	4	2	**100**
Soil preparation method	Ridging	Ploughing	Zero tillage			
	100	0	0			**100**
	Major season			Minor season		
Period of growing tomato	March-April	May-June		September	October	
	85	15	**100**	90	10	**100**
Type of fertilizer applied	NPK and urea	NPK and ammonia sulphate	NPK and Sidalco foliar fertilizer	NPK alone		
	15	70	10	5		**100**
Amount of fertilizer used	1bag NPK and ½ bag/ha Ammonia Sulphate	2bags NPK and 1bag/ha Ammonia Sulphate	3 bags NPK and 1 bag/ha Ammonia Sulphate			
Total (%)	5	70	25			**100**

3.4 Insecticides and Fungicides Used in the Management of Pests and Diseases on Tomato by the Farmers in the Surveyed Area

The result showed that the farmers used mainly insecticides and fungicides to control pests and diseases on tomato (Table 4).

Most of the respondents used Dithane M-45 (95%) to control diseases on tomato followed by Kocide (5%). For the insecticides, majority of the respondents (38.6%) used Attack followed by Lamda and Karate with 28.8 and 15.4%, respectively. Other insecticides used by the respondents were Golan (4.5%), Confidor (4.1%), Control (2.7%), Dusban (3.2%) and Combat (2.7%) (Table 4).

3.5 Crop Rotation Systems Practiced by Respondents in the Surveyed Area

There were ten crop rotation systems outlined by the respondents during the survey (Fig. 2).

The most predominant system (30%) practiced by the respondents in a three-rotational cycle was tomato followed by pepper and then cassava. The other systems practiced were: tomato-pepper-fallow, tomato-pepper-plantain, tomato-cassava-tomato, tomato-cassava-fallow and tomato-maize-tomato with 10% each (Fig. 2). Five percent (5%) of the respondents practiced tomato-fallow-tomato, tomato-garden egg-okra, tomato-cassava-cowpea and tomato-tomato-maize.

Table 2. Pests and diseases associated with tomato production by the respondents in the surveyed area

Activity	Percent respondents						Total (%)
	Pests				Diseases		
Type of pests and diseases reported	Root-knot nematode	Fruit borers (caterpillars)	Whitefly	Mites	Damping-off and wilting	Leaf curl	
Total (%)	30	25	20	5	10	10	**100**

Table 3. Management practices carried out by the respondents in the surveyed areas

Category of pesticide used	Percent respondents				
	Insecticide and fungicide	Insecticide alone	Fungicide alone	Nematicide	Total (%)
Total (%)	95	5	0	0	100
Other pests and diseases management methods	Crop rotation and weeding				
Total (%)	100				100

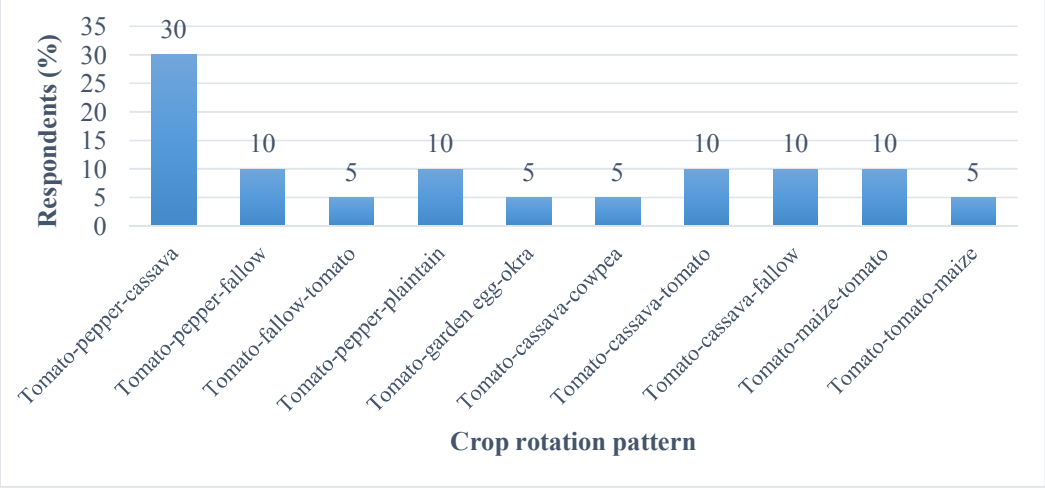

Fig. 2. Crop rotation pattern practiced by respondents as root-knot nematode management strategy

Table 4. Insecticides and fungicides used by farmers to control pests and diseases on tomato

Pesticide type				Percent respondents
Fungicides	**Active ingredient**	**Manufacturer**	**Country**	
Dithane M-45	Mancozeb	Dow Chemical Company LLC	China	95.0
Kocide	Cupric hydroxide	Certis Company	United States of America	5.0
Total (%)				**100.0**
Insecticides	**Active ingredient**	**Manufacturer**		**% Frequency**
Golan	Acetamiprid	ADAM Agricultural Solution Ltd	Israel	4.5
Attack	Emamectin benzoate	Anchor Allied Factory Ltd.	United Arab Emirates	38.6
Lambda	Lambda cyhalothrin	Syngenta Group Company	China and India	28.8
Confidor	Imidacloprid	Bayer	China	4.1
Control	Emamectin benzoate	Anchor Allied Factory Ltd.	United Arab Emirates	2.7
Karate	Lambda cyhalothrin	Syngenta Crop Protection AG	Switzerland	15.4
Combat	Lambda cyhalothrin	Aceto Agricultural Chemical Corporation	United States of America	2.7
Dusban	Chlorpyrifos ethyl	Shenzhen Yufull Industry Company Limited	China	3.2
Total (%)				**100.0**

Table 5. Length of fallow period practiced by tomato farmers in the surveyed area

Period of fallow	Percent respondents/year(s)			Total (%)
	1 year	**2 – 3 year**	**4 – 5 years**	
Total (%)	20	70	10	**100**

Table 6. Effectiveness of pest and disease management methods by the respondents in the surveyed area

Pests and diseases management practices	Percent respondents			
	Not effective	**Less effective**	**Effective**	**Total (%)**
Insecticides against insect pests	0	0	100	**100**
Fungicides against diseases	0	0	100	**100**
Crop rotation and weeding against root-knot nematodes	15	85	0	**100**

The majority of the respondents (70%) practiced two and three years fallow periods, followed by one year (20%). Ten percent (10%) of the respondents practiced fallow periods between 4 and 5 years (Table 5).

3.6 Effectiveness of Management Practices of Tomato Farmers in the Surveyed Area

The effectiveness of management practiced by the respondents against insect pests, diseases

and root-knot nematodes is presented in Table 6. All the respondents said that the management practices against insect pests and diseases were effective. However, 85% of the respondents considered their management practices as ineffective methods against root-knot nematodes, while 15% considered it as less effective. None of the respondents considered their management practices against root-knot nematodes as effective (Table 6).

4. DISCUSSION

Most of the respondents planted tomato in March/April for the major season and September for the minor season. According to respondents, this was done at the onset of the rains to enable them harvest earlier with good market price. This agrees with Adu-Dapaah and Oppong-Konadu [9] who reported that majority of farmers who grow tomato in the major season planted from mid-March to April, while that of the minor season was done around September.

The results revealed that Power tomato variety was the most cultivated in the surveyed area.

This is in line with Robinson and Kolavalli [14] who reported that Power variety was widely used by most of the farmers under rainfed conditions in Ghana.

The land area used by the respondents for tomato production varied in size among the farmers. This result is consistent with Asare-Bediako and Micah [10] who stated that farm sizes of the majority of vegetable farmers in Ghana ranged from less than 0.4 to 4 ha. Also, Aidoo et al. [15] indicated that, the farmers cultivate tomato on farm sizes of 2.0 ha on the average. This shows that tomato cultivation is done by smallholder farmers. Ministry of Food and Agriculture [16] reported that in Ghana, vegetable production is mainly on small-scale basis.

The farmers applied mainly chemical fertilizers to improve soil fertility and most of the respondents used NPK and $(NH_4)_2SO_4$ as basal and topdressing, respectively. However, few number of them applied NPK alone after transplanting. Different rates of the fertilizers were observed to be used by farmers on tomato. Donkoh et al. [17] observed intensive use of inorganic fertilizer by tomato farmers in northern Ghana.

In the case of pests and diseases, root-knot nematode was indicated by most of the respondents as the major pest infesting tomato in the surveyed area. The majority of the respondents said that they were aware of the damage caused by the nematode. They reported that they have learnt the problem of nematodes from the trainings received from Ministry of Food and Agriculture or from other farmers. This observation agrees with findings of Asare-Bediako and Micah [10] who found root- knot nematodes as the major pest of tomato in Ashanti Region. The authors further indicated that other pests frequently came across and described by the farmers were insect larvae (caterpillars) and whitefly. The result on diseases of this study is in line with that of Adu-Dapaah and Oppong-Konadu [9] who found damping-off and wilting as economically important constraints on tomato production in Ashanti Region.

Pesticides were observed to be widely used by farmers in the study area. All the farmers interviewed applied insecticides to control pests on tomato. Heavy use of insecticides by farmers can be explained by the economic importance of fruit borers and whiteflies on tomato. This is in agreement with Owusu-Boateng and Amuzu [18] who observed over-reliance on synthetic insecticides in the management of pests and diseases by vegetable growers in Ghana.

Similarly, Asare-Bediako and Micah [10] stated that only few of the respondents used pesticides for disease control, indicating that pests, but not diseases are the major limiting factors to the production of various vegetables. None of the respondents mentioned the use of nematicides during the survey. This is in agreement with Asare-Bediako and Micah [10] who reported that the types of pesticides commonly used by vegetable farmers were insecticides (61.7%), followed by fungicides (32.7%) and herbicides (5.5%).

All the respondents reported that they practiced crop rotation as management method to control pests and diseases particularly, root-knot nematodes. The most common cropping system outlined by majority of respondents was tomato-pepper and cassava in sequential order. Similar result was obtained by Asare-Bediako and Micah [10] who indicated that farmers cultivated pepper after tomato in a three- rotational cycle. This type of crop-rotational cycle can have negative impact on the second crop (pepper) as the first crop (tomato) may be susceptible and favour root-knot nematode build-up. The initial inoculum in pepper will be so high that the desired output might not be obtained due to serious nematode damage to

the crop. For crop rotation to be effective, crops unsuitable for nematode infestation, reproduction and development must be introduced in the rotation system. According to Noling [19], repeated planting of the same crop or of the same family in the field without interruption will enable some root-knot nematode species to reproduce successfully. Damage caused by *Meloidogyne* spp. is related to their population densities in soils at planting and their reproduction potential [20].

5. CONCLUSION

Power is the commonest tomato variety found to be cultivated in the surveyed area. Planting of tomato was done at the onset of the rains in the major and minor seasons. The farm sizes were generally small and chemical fertilizer was mainly used as soil amendment. The knowledge of tomato farmers in determining the damage of root-knot nematodes was high. Root-knot nematodes were observed as the most important pest in tomato production, followed by fruit borers and whiteflies. In general, the farmers used pesticides such as Attack, Lambda and Karate to control pests, while Dithane M-45 and Kocide were used to control fungal diseases. Beside pesticide application, tomato farmers also practiced crop rotation as pests and diseases management option. The respondents indicated that management methods against root-knot nematodes were ineffective. The insecticides and fungicides were found to be effective against insect pests and fungal disease pathogens by all the respondents in the surveyed area. Tomato farmers should be trained on cop rotation systems that are effective in reducing pests and disease incidence and severity on tomato plant. The Ministry of Food and Agriculture should organize training for tomato farmers on pesticide usage, safety and disposal, since it is the only means of control for insect pests and diseases on tomato.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Osei MK, Akormah R, Shilh SL, Green SK. Evaluation of some tomato germplasm for resistance to Tomato Yellow Leaf Curl Virus disease (TYCV) in Ghana. Aspects Applied Biology. 2010;96:315-323.
2. Asare-Bediako E, Showemimo FA, Buah JN, Ushawu Y. Tomato production constraint at Bolgatanga. Journal of Applied Sciences. 2007;7(3):459-461.
3. Srinivasan R. Safer tomato production techniques: A field guide for soil fertility and pest management. AVRDC Publication. 2010;92-9058-182-4.
4. Ghana Investment Promotion Center (GIPC). Ghana Investment Profile on Cash Crop; 2013. Available:http://www.ghanaiandiaspora.com/wp/wp-content/uploads/2014/08/GIPC-SectorProfile_DoingBusiness_ForApproval-1.pdf (Accessed; 2015)
5. Wolff H. Economics of tomato production with special reference to aspects of plant protection: A case study of two tomato production systems in Brong-Ahafo Region, Ghana. Prepared for Ghanaian–German Project for Integrated Crop Protection. GTZ: Eschborn. 1999;131.
6. Ministry of Food and Agriculture. Agriculture in Ghana. Facts and Figures. Statistical Research and Information Division, Ministry of Food and Agriculture, Accra; 2010. Available:http://www.mofa.gov.gh (Accessed; 2015)
7. Ntow WJ, Gijzen HJ, Kelderman P, Drechsel P. Farmer perceptions and pesticide use practices in vegetable production in Ghana. Pest Management Science. 2006;62:356-365.
8. Anang BT, Zakaria AZ, Yusif S. Production constraints and measures to enhance the competitiveness of the tomato industry in Wenchi Municipal District of Ghana. American Journal of Experimental Agriculture. 2013;3(4):824-838.
9. Adu-Dapaah, HK, Oppong-Konadu EY. Tomato production in four major tomato growing districts in Ghana: Farming practices and production constraints. Ghana Journal of Agricultural Science. 2002;35:11-22.
10. Asare-Bediako E, Micah JA. Vegetable crop protection practices and policy related issues in the rural and peri-urban areas of the cocoa belts of the Ashanti and Western Regions of Ghana; 2014. Available:http://www.humidtropics.cgiar.org/wp-content/plugins/download.../download.php (Accessed; 2015)
11. Ministry of Food and Agriculture (MoFA). Ministry of Food and Agriculture Report; 2012.

12. Available:http://www.mofa.gov.gh. (Accessed; 2015)
13. Ministry of Food and Agriculture (MoFA). Ministry of Food and Agriculture Report; 2013. Available:http://www.mofa.gov.gh (Accessed; 2015)
14. Attoh C, Martey E, Kwadzo GTM, Etwire PM, Wiredu, AN. Can farmers receive their expected seasonal tomato price in Ghana? A probit regression analysis. Sustainable Agriculture Research. 2014;3(2):1927-050X.
15. Robinson EJZ, Kolavalli SL. The case of tomato in Ghana: Productivity development and strategy governance division, IFPRI, Ghana Strategy Support Program (GSSP). GSSP Working Paper. 2010;19.
16. Aidoo R, Danfoku RA, Mensah OJ. Determination of postharvest losses in tomato production in the Offinso North District of Ghana. Journal of Development and Agricultural Economic. 2014;6(8):338-344.
17. Ministry of Food and Agriculture. Agriculture in Ghana. Facts and Figures. Statistical, Research and Information Division, Ministry of Food and Agriculture, Accra; 2011. Available:http://www.mofa.gov.gh (Accessed; 2015)
18. Donkoh SA, Tachega M, Amowine N. Estimating technical efficiency of tomato production in northern Ghana. American Journal of Experimental Agriculture. 2013; 3(1):56-75.
19. Owusu-Boateng G, Amuzu KK. A survey of some critical issues in vegetable crops farming along River Oyansia in Opeibea and Dzorwulu, Accra-Ghana. Global Advanced Research Journal of Physical and Applied Sciences. 2013;2(2):24-31.
20. Noling JW. Nematode management in tomatoes, peppers, and eggplant. United States Department of Agriculture, UF/IFAS Extension Service, University of Florida; 2010. Available:www.http://edis.ifas.ufl.edu/ng032 (Accessed; 2015)
21. Wesemael WML, Moens M. Quality damage on carrots (*Daucus carota* L.) caused by root-knot nematode, *Meloidogyne chitwoodi*. Nematology. 2008; 10:261-270.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/13132