



RESEARCH ARTICLE

SURVEY ON COWPEA [*VIGNA UNGUICULATA* (L.) WALP] CULTIVATION IN UPPER EAST REGION OF GHANA

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ABSTRACT

Cowpea [*Vigna unguiculata* (L.) Walp] is an important food crop with ability to enhance soil fertility. In northern Ghana, cowpea is the second most important crop after groundnut and a cheap source of protein in the diet, hence it is critical to improve production of the crop. This study assessed the demography, farm characteristics and extent of cowpea cultivation in the Upper East region of Ghana. Multi-stage random sampling technique was used to identify 200 respondents, 179 cowpea farmers and 21 agriculture extension officers in five cowpea growing districts involving closed and opened ended questions. Majority of the farmers (60.9 %) were males between the ages of 21 and 60 (85.5 %), who had no formal education (63.1 %). The agricultural extension officers (AEOs) involved in the study were all males, ranging from 21 years to 56 years, with Higher National Diploma (HND) (47.6 %). In all, 79 % of the cowpea farmers had average cowpea farm sizes of 1-5 acres indicating that cowpea cultivation in the region is on small scale, mostly by subsistent farmers. The level of cowpea cultivation is probably on the increase in the region due to recent access to improved seed and ready market. Farmers employ the use of pesticides and crop rotation in controlling pests and diseases on cowpea. Weed control on cowpea farms is mostly by the traditional weeding using the hoe and cutlass and the use of herbicides. The mode of conservation of cowpea grains includes the use of sieved ashes (42.9 %), insecticides (23.8 %) and plant extracts (9.5 %), involving dried powdered neem tree leaves. On the whole, cowpea is a promising economic crop towards food security and income generation but farm sizes are small. Therefore, cultivation of cowpea has to be given the needed priority and support for farmers to expand their farms to increase productivity.

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INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most ancient human food sources and a crop plant since Neolithic times (DPP, 2011). Cowpea is grown worldwide with an estimated cultivation area of about 14.5 million hectares and worldwide production of over 4.5 million metric tons annually (Singh, et al., 2002). Nigeria is the world's leading cowpea producing country, followed by Brazil. Other countries in Africa, such as Senegal, Ghana, Mali, Burkina Faso, Niger, and Cameroon, are also significant producers of the crop (Fowler, 2000; DPP, 2011). In West and Central Africa, cowpea is usually cultivated by subsistence farmers on small scale as intercrop, in rotations or relay cropping with cereals such as sorghum, millet, and maize (Carlos, 2004). In Ghana cowpea can be cultivated in all the agro-ecological zones.

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It is however, important to note that, the bulk of cowpea production in Ghana is mainly found in the Guinea savannah and the Transition agro-ecological zones (Quaye et al., 2011). The choice of cowpea for cultivation depends on local farmers' preferences for yield, earliness, grain size and coat colour (MoFA, 2010). Cowpea is mostly produced for household purposes and as a cash crop. It is a multipurpose and a multifunctional crop, cultivated for the leaf and seed; providing food for human and livestock and serving as a valuable and dependable revenue-generating commodity for farmers and grain traders (Schippers, 2002; Singh, 2002; Langyintuo, 2003). Cowpea is cultivated in most of the agro-ecological zones of Ghana based on local preferences but the bulk of the cowpea production in Ghana is largely found in the Guinea Savannah and Forest Transition zones (ICRISAT, 2012; MoFA, 2010; Quaye et al., 2011). The crop plays a very important role towards achieving food security due to its high nutritional content of 23-30% protein, 50-67% carbohydrate, 1.9% fat, 6.35% fiber and small percentage of the B-vitamins

such as folic acid, thiamine, riboflavin as well as some micronutrients (Iron, Phosphorus, Zinc and Calcium) that improve human nutrition and health status (Bressani, 1985; Chinma *et al.*, 2008; Sefa-Dedeh *et al.*, 2011). Cowpea is being considered as a healthy alternative to soya bean as consumers look for more traditional food sources that are low in fat and high in fiber, with other health benefits (Moore and Ming, 2008). The Upper East region of Ghana which lies in the Sudan savannah agro-ecological zone, is making strides in cowpea production in the country. According to a legume market survey sponsored by Bill and Melinda Gates Foundation in 2012, the Upper East region is the third leading cowpea producing region in Ghana after the Northern and Upper West region which both lie within the Guinea savannah agro-ecology. The current study was to assess the demography, farm characteristics and extent of cowpea cultivation in the Upper East region of Ghana.

MATERIALS AND METHODS

Description of Study Area

The Upper East Region (UER) of Ghana lies between longitude 1015'W to 005'E and stretches from latitude 10030'N to 1108'N. The region lies in the Sudan savannah agro-ecology, which forms the semi-arid part of Ghana. The area is part of what is sometimes referred to as interior savannah, and is characterized by level to gently undulating topography (Issah *et al.*, 2013). The region has alternating wet and dry seasons with the wet season occurring between June and October during which about 95 % of rainfall occurs. Maximum rainfall occurs in August, and severe dry conditions exist from November to May each year. Annual rainfall ranges from 800-1200 mm. There is wide fluctuation in relative humidity (RH) with as low values as 25 % in dry season and above 75 % in the wet season. The study was carried out from August to September, 2016. The research tool employed was the administration of both closed and open-ended questionnaires. Information was generated from 200 respondents made up of 179 cowpea farmers and 21 Agricultural Extension Officers (AEOs) from 14 communities in 5 main cowpea production districts: Binduri, Builsa South, Garu-Tempene, Kasena-NankanaMunicipal and Talensi (Table 1).

Table 1. The Districts, Communities and Number of Respondents involved in the Survey

District	Communities	Number of farmers	Number of Extension officers	Number of respondents
Binduri	Kumpalgoga	12		40
	Tambigu	12	4	
	Tansia	12		
	Gbedembilisi	12		
Builsa South	Uwesi	12	4	40
	Wiasi	12		
Garu-Tempene	Gosieko	14		39
	Konkomada	21	4	
Kasena-Nankana Municipal	Bonia	12		40
	Nayagenia	12	4	
Talensi	Wuru	12		41
	Balungu	12		
	Gbeo	12	5	
	Winkongo	12		

Only the major cowpea production communities in these districts were selected, and farmers with at least one year

experience in cowpea cultivation were selected to respond to the questionnaire. The selection of the districts, communities and farmers for the study was in consultation with the Regional Crop Officer, District Crop Officers and Agriculture Extension officers of the Ministry of Food and Agriculture (MoFA) respectively. The instruments used captured data on demography, farm characteristics, farming methods used in cowpea cultivation, level and extent of cowpea production and method of storage of cowpea grains in the region. Data collected from the survey on the farmers and AEOs perceptions on cowpea cultivation in the Upper East Region, were subjected to simple qualitative analysis using IBM SPSS Statistics 19.

RESULTS

Demography

Majority of the farmer respondents (60.9 %) were males between the ages of 21 and 60 (85.5 %), with no formal education (63.1 %) (Tables 2, 3 and 4).

Table 2. Gender of Farmers

Respondents	Frequency	Percentage (%)
Male	109	60.9
Female	70	39.1
Total	170	100.0

Table 3. Age Distribution of Farmers

Age	Frequency	Percent
21-30	30	16.8
31-40	49	27.4
41-50	41	22.9
51-60	33	18.4
61-70	14	7.8
71-80	7	3.9
81-90	1	0.6
91-100	4	2.2
Total	179	100.0

Table 4. Academic Qualification of Farmers

Qualification	Frequency	Percent
Illiterate	113	63.1
Primary	32	17.9
JHS/JSS	14	7.8
Secondary	12	6.7
Diploma	5	2.8
Bachelor	3	1.7
Total	179	100.0

Only 36.9 % of the respondent had some formal education, ranging from primary to tertiary. However, majority of the resource-poor farmers (57.5 %) had 1-5 years farming experience in cowpea cultivation (Table 5).

Table 5. Number of year of farming experience

Years	Frequency	Percent (%)
1-5	103	57.5
6-10	52	29.1
11-15	7	3.9
Above 15	17	9.5
Total	179	100.0

All the agricultural extension officers (AEOs) who responded to the questionnaire for this particular research, were males,

ranging from 21 years to 56 years. Most of them had a Higher National Diploma (HND) (47.6 %), and a bachelor degree (33.3 %), with 1-35 years of working experience (Tables 6, 7 and 8).

Table 6. Ages of AEOs

Age	Frequency	Percent (%)
21-30	6	28.6
31-40	10	47.6
41-50	1	4.8
51-60	4	19.0
Total	21	100.0

Table 7. Educational Qualification of AEOs

Education	Frequency	Percent (%)
Diploma	10	47.6
Bachelor	7	33.3
Masters	2	9.5
Others	2	9.5
Total	21	100.0

Table 8. Number of year as Extension Officers

Years	Frequency	Percent (%)
1-5	12	57.1
6-10	3	14.3
11-15	1	4.8
16-20	1	4.8
26-30	3	14.3
31-35	1	4.8
Total	21	100.0

Farm Characteristics

Over 70% of the farmers had average cowpea farm sizes of 1-5 acres, and just a little over 11 % of the farmers had more than 5 acres of cowpea farms (Figure 1).

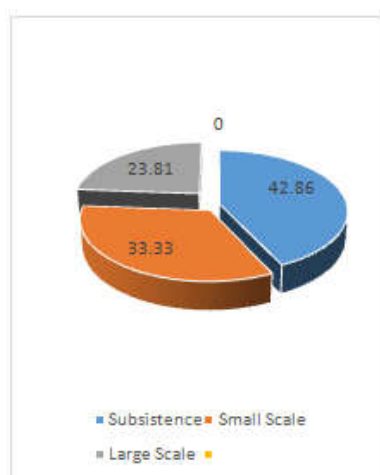


Figure 1. Average cowpea farm size

Most farmers with farm sizes above 5 acres were from the Builsa South district with a few from the Talensi district. The methods employed by the farmers in the cultivation of cowpea in the region included mono-cropping (76 %), mixed cropping (6.1 %) and crop rotation (16.2 %). Reasons associated with mono-cropping of cowpea as indicated by farmers include:

- To ensure proper management of the crop since cowpea unlike other food crops, needs a lot of attention.

- To maximize the yield of the crop. Farmers were of the view that if cowpea is mixed cropped, it reduces the yield.
- To ensure proper aeration of the crops.
- A directive from the agriculture extension officers.

Those who practice crop rotation said that they rotated cowpea with cereals such as maize, millet, sorghum and guinea corn to help replenish the used nutrients and enrich the soil as well as to optimize the use of the land. Farmers also said they mix-crop their local cowpea (referred to as 'beans'). The local cowpea varieties are mostly creeping. Erect and improved cowpea varieties (which the farmers call 'cowpea'), were mostly cultivated in a mono crop system. The average farm size for cowpea cultivation in the region according to the AEOs, ranges from 1-5 acres (81 %), with only a few of them saying it could be more than 5 acres (19 %). This is a confirmation of the data from the cowpea farmers. This means that cowpea cultivation in the region is mostly on very small scale. The farming systems employed by farmers in the cultivation of cowpea are mono-cropping (47.6 %), crop rotation (23.8 %) and mixed cropping (9.5 %). According to the AEOs, farmers in the upper East region of Ghana, usually mix crop local creeping varieties with cereals. Improved cowpea varieties which are usually erect are cultivated in mono-cropping or crop rotation system. To the AEOs, improved varieties usually require much attention and are better managed if they are grown alone.

Extent of Cowpea Production in the Upper East Region

Cowpea cultivation in the Upper East region of Ghana, according to respondents is mostly on subsistence (42.86 %) and small scale (33.33 %) basis. Only a few of the farmers especially in the Builsa South district, cultivate cowpea on large scale (23.81 %) basis (Figure 2).

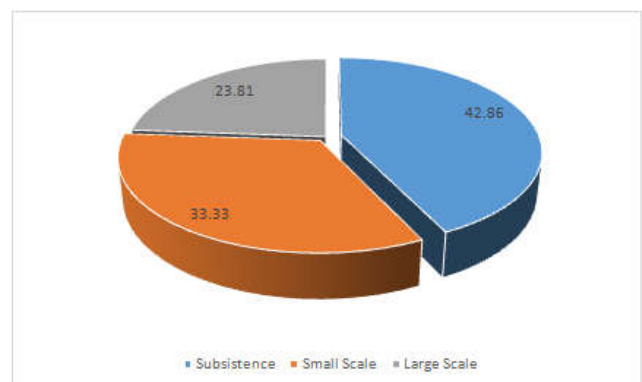


Figure 2. The Extent of Cowpea cultivation in the Upper East Region of Ghana

This well reflected in the average farm size for the cultivation of cowpea which ranged from 1-5 acres. Farmers who are into small and large scale production of cowpea as a business are not many in the region. According to the AEOs, commercial production of cowpea in the region is mostly in the Builsa North and South district (70% of farmers), who are along the river Sissili. A few of the farmers in the Talensi district especially those along the White Volta are also into commercial production of cowpea. Farmers into commercial production of cowpea in the Upper East Region of Ghana were about 300-350.

On the total land used for cowpea, the respondents said that over 30000 acres of land is used for cowpea cultivation in the region. Once again it was said that close to 70 % of this land is found in the Builsa North and South districts.

Level of Cowpea Cultivation

Cowpea production level in the region has increased as observed by 66.7 % of farmers. This, according to the respondents is as a result of the introduction of new improved cowpea varieties which are high yielding and early maturing. It is also because of the ready market for cowpea that is encouraging more farmers to venture into cowpea production. Besides, the intense education on proper management of the crop by the MoFA, was also a contributory factor to the increase in cowpea production. However, 33.3 % of the respondents were of the view that the production levels of cowpea in their areas of supervision had decreased. They attributed the reduction in cowpea production to low erratic rain fall due to climate change, pests and insect attack, effect of the parasitic weed, *S. gesnerioides*, lack of access to quality seeds and high cost of management of the crop. Most farmers have either stopped the cultivation of cowpea or have reduced their production levels as a result of these challenges, most especially the effect of the parasitic weed, *S. gesnerioides*.

Ready Market and Uses of Cowpea

The respondents (90.5 %) agreed that there was a ready market for cowpea in the Upper East Region. They cited the Bawku and Bolgatanga markets as main market centres. They added that people within their areas of supervision, use a lot of cowpea in their diets. Cowpea is the only grain legume that could be eaten throughout the day. It could be taken in the form of 'koose' (Fried Bean cake) with porridge as breakfast in the morning. It is cooked with rice as 'Waakye' which could be taken at breakfast, lunch or dinner. Other foods prepared from cowpea include, Tubani (Boiled bean cake), Gari and beans and can be cooked and eaten alone.

Pests, Disease and Weeds Control

Farmers in the Upper East Region, do not have one single method of controlling pest and diseases in cowpea production.

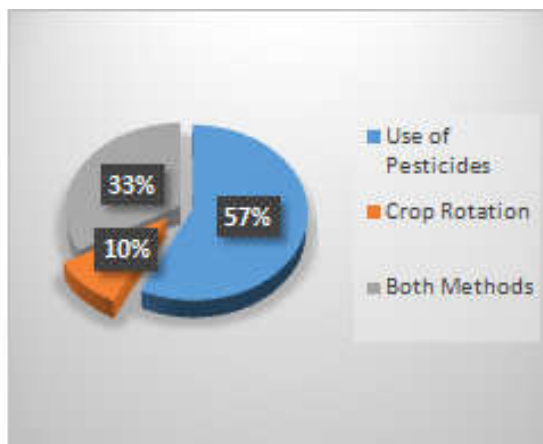


Figure 3. Methods of controlling Pests and Disease on cowpea farms

They employ the use of pesticides and crop rotation in controlling pests and diseases on cowpea (Figure 3). Traditional weeding using the hoe and cutlass and the use of herbicides are methods employed by farmers in controlling weeds in cowpea farms (Figure 4).

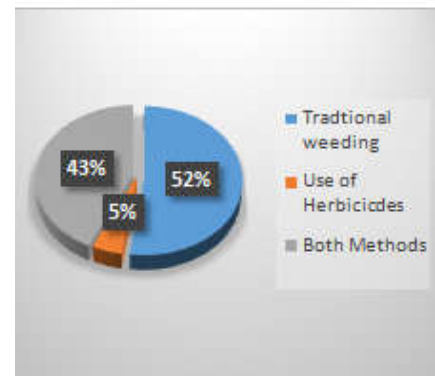


Figure 4. Methods of controlling weeds on cowpea farms

Storage of Cowpea

The farmers in the Upper East region mostly store the cowpea grains in sieved ashes (42.9 %) from cooking fires. Others use insecticides (23.8 %) and plant extracts (9.5 %), such as dried powdered neem tree leaves (Figure 5).

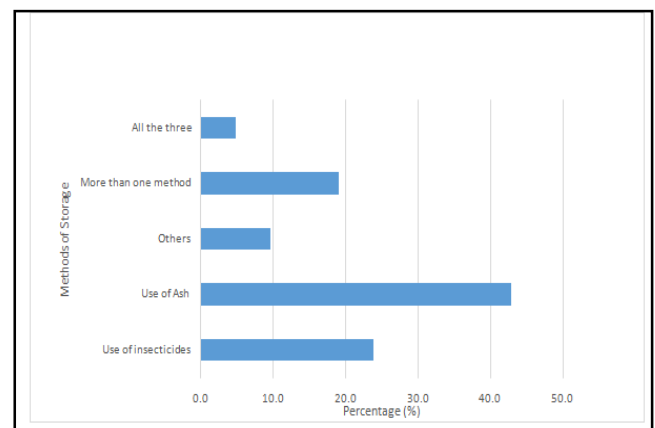


Figure 5. Methods of storage of cowpea grains Others- Use of Plant Extracts and PICS Bags

DISCUSSION

Demographic Data

The observed 60% of the cowpea farmers made up of males who were married appeared contrary to the report by (Akpaluet *et al.*, 2013), on the cultivation and utilization of Bambara beans in the Sumbrugu community of Bolgatanga. They reported that 57 % of females were involved in the cultivation of Bambara beans, with the male percentage of 43. The current results were however in line with the report from the agricultural production survey for the northern regions of Ghana for the year 2014, which showed that 90 % of farmers in the northern regions were males and the 10 % being females (Amanor-Boaduet *et al.*, 2015). Over 70 % of the farmers were between the ages of 20 and 50. This indicates that a good number of the youth were involved in cowpea cultivation and agriculture as a whole in the region. This is in line with the national cry for the youth employment in agriculture, to increase food production and reduce poverty. English is important for individuals' long-term economic wellbeing because it is Ghana's official language (Amanor-Boaduet *et al.*, 2015). While significant effort is being made by the government to enhance formal education in the country, over 85 % of the farmers in the Upper East region of Ghana, either had no formal education, or very little education (Primary education).

They could therefore not speak or write in English. This could affect their production as they cannot read simple instructions on chemicals, fertilizers and other inputs. Manuals from training workshops cannot be easily used by farmers because of illiteracy. Amanor-Boadu and his colleagues (Amanor-Boadu *et al.*, 2015), reported that only 12.5% of 526 farmers in the northern regions of Ghana could read and write in English. The agriculture sector in the region is dominated by the illiterates. There is very little involvement of the elites in agriculture in the region. This could be a very serious challenge to agricultural production in the region and Ghana at large. However, adult literacy evening community classes for farmers could improve the current situation significantly.

Cowpea cultivation and Utilization in the Region

Cowpea is the second most important legume in Ghana, after groundnuts (Bill and Melinda Gates Foundation, 2012). Cowpea is more drought tolerant than other legumes and many farmers in Ghana are shifting their production to cowpea. Cowpea production in the Upper East region, is mostly subsistence farming. Despite the drift towards cowpea production in Ghana as reported by the Legume Market Overview in 2012, the average cowpea farm from the current study, is 1-5 acres. This indicates that cowpea cultivation in the region is mostly subsistent or on very small scale. Only a few of the farmers especially in the Builsa North and South districts are into commercial and large scale production. The Legume Market overview (Bill and Melinda Gates Foundation, 2012), reported a decline in cowpea production from 45,000 metric tons in 2007 to about 25,000 metric tons in 2010 in the Upper East region. Events have changed and cowpea production in the region according to the AEOs (66.7 %) has increased despite the fact that some of them (33.3 %), were of the view that cowpea production in the region has reduced. Reasons for the increase in production include; introduction of improved quality and high yielding varieties, ready market for cowpea and low cost of production. The production of cowpea in the region is however challenged by pest and insect attack, *S. gesnerioides*, poor soil fertility, low and erratic rainfall, Cowpea is susceptible to a wide range of pests and diseases at all stages of its growth cycle (Allen, 1983). Losses due to Pests and diseases can be as high as 90-100 % (IITA, 2000).

Farmers in the region mostly use pesticides in the control of pests and diseases. The Bawku and Bolgatanga markets are very big markets where traders from all parts of the country, come to buy and sell their produce. They serve as the main marketing centres for cowpea in the region. There are other smaller markets all over the region where cowpea could easily be sold. Aside the markets, there are many Senior High Schools in the region, at least one in each of the districts. These institutions are always demanding for cowpea to feed their students and therefore serve as a huge market for cowpea. According to the United Nations World Feeding Program (UNWFP, 2010), the WFP aims at buying 2000 metric tons of cowpea annually for schools and households feeding programs in Ghana. This also serves as market for cowpea in the region. Farmers in the Upper East region of Ghana, mostly store their cowpea grains in sieved ashes. Golob and Webley (1980) reported that, in many parts of sub-Saharan Africa, farmers often mixed their cowpea grain with sieved ash from cooking fires, or with sand, in the hope of protecting their grain from bruchids.

A survey of cowpea storage by Climate Science Research Partnership (CSRP) scientists in northern Cameroon confirmed

that ash usage is common among small scale farmers. However, farmers differed widely in the way they use ash, especially in the proportions of ash to grain. Some dusted their cowpeas lightly with ash, others used a large excess of ash over the grain, while still others used alternate layers of cowpeas and ash (Wolfson *et al.*, 1991).

Conclusions

The agriculture sector in the Upper East region is dominated by farmers who have no or little formal education. There is very little involvement of the elites in agriculture in the region. Majority of the farmers (60.9 %) were males between the ages of 21 and 60 (85.5 %), who had no formal education (63.1 %). The agricultural extension officers (AEOs) involved in the study were all males, ranging from 21 years to 56 years, with Higher National Diploma (HND) (47.6 %). In all, 79 % of the cowpea farmers had average cowpea farm sizes of 1-5 acres indicating that cowpea cultivation in the region is on small scale, mostly by subsistent farmers. Grains of cowpea are mostly stored using wood ash.

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REFERENCES

- Akpalu, M.M., Atubilla, I.A., Opong-Sekyere D. 2013. Assessing the Level of Cultivation and Utilization of Bambara Groundnut (*Vigna Subterranea* (L.) Verdc.), in the Sumbrungu Community of Bolgatanga, Upper East Region, Ghana. *International Journal of Plant, Animal and Environmental Sciences*, 3 (3): 68-75.
- Allen, D. J. 1983. The pathology of tropical food legumes. John Wiley and Sons, Chichester, 37-45.
- Amanor-Boadu, V., Zereyesus, Y., Kara, R., Ofori-Bah, A., Adams S, Asiedu Dartey, J., Gutierrez, E., Hancock, A., Mzyece, A., Salin, M. 2015. Agricultural Production Survey for the Northern Regions of Ghana: 2013-2014 Results. Final Report.
- Bill and Melinda Gates Foundation. 2012, Legume Market Analysis, Ghana.
- Bressani, R. 1985. Nutritive value of cowpea. Pp 353-360 in Cowpea: Research, Production and Utilization, edited by Singh, S. R. and Rachie, K. O. John Wiley & Sons, New York, 89-95.
- Bulletin of tropical legumes. www.icrisat.org/
- Carlos, G. 2004. COWPEA: Post-Harvest Operations. Food and Agriculture Organization of the United Nations (FAO).
- Chinma, C.E., Alemede, I.C., Emelife, I.G. 2008. Physicochemical and functional properties of some Nigeria cowpea varieties. *Pakistan Journal of Nutrition*, 7:186-190.
- D., Ibro, G., Moussa, B., Kergna A, Kushwaha S, Musa S, Ntougam G. 2003. Cowpea supply and demand in West and Central Africa. *Field Crops Resources*, 82: 215-231.
- Directorate Plant Production (DPP), 2011. Department of Agriculture, Forestry and Fisheries. 2011. Production guidelines for Cowpeas. Directorate Agricultural Information Services, South Africa. www.daff.gov.za

- Fowler, C. 2000. Establishing the scope of a multilateral system for plant genetic resources for food and agriculture: implications of crop exclusions. *Biopolicy*3(2). In: *Plant Food and Nutrition Bulletin* 21(4):497-502.
- Golob, P., Webley, D.J. 1980. The Use of Plants and Minerals as Traditional Protectants of Stored Products. Tropical Products Institute Publication No. G138, Overseas Development Administration (ODA), London.
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). 2012. Cowpea farming in Ghana.
- International Institute of Tropical Agriculture (IITA). 2000. Crops and Farming Systems. <http://www.iita.org/crop/cowpea.htm>.
- Issah, S., Francis, K., Roger, A.L.K., Stephen, K.N., Mukhtar, Z. 2013. Sustaining Frafra Potato (*Solenostemon rotundifolius* Poir.) in the Food Chain; Current Opportunities in Ghana. *Journal of Plant Sciences*, 1(4): 68-75.
- Kergna, A., Kushwaha, S., Musa, S., Ntoukam, G. 2003. Cowpea supply and demand in West and Central Africa. *Field Crops Resources*, 82: 215-231.
- Langyintuo, A.S., Lowenberg-DeBoe, R.J., Faye, M., Lambert, Ministry of Food and Agriculture (MOFA). 2010. Agriculture in Ghana, Facts and Figure, PPME: Statistics, Research and Information Directorate (SRID), Accra, 26.
- Moore, P.H., Ming, R. (eds.). 2008. Genomics of Tropical Crop Plants. 227 Springer.
- Quaye W, Adofo K, Buckman ES, Frempong G, Jongerden J, Ruivenkamp G. 2011. A socio-economic assessment of cowpea diversity on the Ghanaian market: Implications for breeding. *International Journal of Consumer Studies*, 35: 679-687.
- Schippers, R.R. 2002. African Indigenous Vegetables, An Overview of the Cultivated Species Revised Version on CD Rom. Natural Resource International Limited, Aylesford, UK. ISBN 0-9539274-5-8.
- Sefa-Dedeh, S., Afoakwa, E.O., Sakyi-Dawson, E. 2011. Comparative Evaluation of Cowpea Varieties and their Performance in a Fermented Food Product. A paper presented at the Annual Meeting of the Institute of Food Technologists, New Orleans, LA. Implications for breeding W.
- Singh, B.B. 2002. Breeding cowpea varieties for resistance to *Strigates nericides* and *Alectravogeli* spp. 154 – 166. In Fatokan, C. A. S. A., Tarawill, B. B. Singh, P. M. Kormawand M. Tamo (editors) 2002. Challenges and 56 opportunities for enhancing sustainable cowpea production. IITA Ibadan Nigeria. 12223–12228.
- Singh, B.B., Mohan, D., Raj, R., Dashiell, K.E., Jackai, L.E.N. 2002. Copublication of International Institute of Tropical Agriculture (IITA) and Japan International Research Centre for Agricultural Sciences (JIRCAS). IITA, Ibadan, Nigeria TropicallegumesII/pdfs/BTL16-20122712.
- United Nations World Feeding Program (UNWFP). 2010. www.wfp.org
- Wolfson, J.L., Shade, R.E., Mentzer, P.E., Murdock, L.L. 1991. Efficacy of ash for controlling infestations of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) in stored cowpeas. *Journal of Stored Produce and Resources*, 27: 239-243.
