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Farmers' Perception and Farming Practices on the Effect of Early and Late Leaf Spots on Groundnut Production in Northern Ghana

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Abstract
Groundnut (*Arachis hypogaea* L.) is an important crop both in subsistence and commercial agriculture in Ghana. Early leaf spot (*Cercospora arachidicola*) and late leaf spot (*Phaeoisariopsis personata*) are major limiting factors to groundnut productivity in Ghana. The objective of the study was to appraise farmers' perception of the disease and effect of the cropping system on the incidence and severity of the disease. A disease-based questionnaire was administered to 100 farmers in their local language spread across 10 villages and towns selected from Tamale, Tolon-Kunbungu and Savelugu-Nanton Districts, all in the Northern Region of Ghana. The responses of the farmers showed that *Cercospora* leaf spot (ELS and LLS) was perceived by the farmers as one of the major constraints to groundnut production in the area to which farmers have no solution The severity of the disease was dependent on the cropping system adopted by the farmers. The variety Chinese turned out to be the most important commercial cultivar grown by farmers but it is susceptible to both diseases.
Keywords: leaf spot, Phaeoisariopsis personata, Cercospora, groundnut, disease

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and grain legume worldwide (Mensah and Obadoni, 2007). It is an important cash crop in subsistence and commercial farming systems, as well as an important food source (Izge *et al*., 2007). Groundnut butter is extensively used in the preparation of soup and as bread spread (Tsigbey *et al*., 2004). According to Marfo (1997), the crop is also an essential component in the cropping system in Northern Ghana because of its ability to fix nitrogen for associated or subsequent cereal crops.

According to FAO estimates, the average world production of groundnut pods in 1999-2003 was about 34.4million t/year from 24.4million hectares of land (Ntare, 2007). The total production in sub-Saharan Africa was 8.2million t/year from 9.5million hectares of land (Ntare, 2007). In Ghana, groundnut is grown in all agro-ecological zones. About 85% of the area under groundnut production is in the Guinea and Sudan savannah zones (Atuahene-Amankwa *et al*., 1988). However, smaller quantities are produced in all parts of the country (Tweneboah, 2000). Groundnut cultivation is a major agricultural activity for the people of the northern regions of Ghana. It is both a commercial and subsistence venture for majority of the inhabitants (Tsigbey *et al.,* 2004). Average yields, however, continue to remain below 1.0 t/ ha which is far below the potential yields of 2.0-3.0 t/ ha (Asibuo *et al.,* 2008).

In Ghana, the major constraint to groundnut production is disease incidence, particularly, early leaf spot caused by *Cercospora arachidicola* and late leaf spot by *Phaeoisariopsis personata* (Frimpong *et al.,* 2006a).

Both early and late leaf spots diseases are widely distributed and occur in epidemic proportions in northern Ghana (Nutsugah *et al*., 2007a). Losses due to diseases can be attributed to the high percentage of defoliation caused by leaf spot diseases, which thus affect pod filling and subsequent grain yield. Defoliation percentage affects hay quality of vines that are fed to animals (Tsigbey *et al.,* 2004). Diseases of groundnut reduce yield and quality of grains and increased cost of production wherever the crop is grown (Wynne *et al.,* 1992).

This study appraised farmer's perception of early and late leaf spot diseases, farming practices that increase the incidence and severity of early and late leaf spot diseases and the effect of the diseases on groundnut production.

MATERIALS AND METHODS

Survey of groundnut production areas in Tamale and surrounding towns and villages

Villages and farmers covered in the survey were selected with the help of CSIR-Savanna Agriculture Research Institute (CSIR-SARI) and some Extension staff from Ministry of Food and Agriculture (MOFA). Majority of the farmers were clustered within ten villages namely; Dindo, Savelugu, Tingoli, Kpalsorgor, Worborgor, Datoyilli, Tolon, Kunbungu, Chanayili, Cheyorhe, and the rest at the outskirts of Tamale Metropolis. Tamale, Datoyili, and chanayili were selected from Tamale district, Savelugu from Savelugu-Nanton district, and the rest of the towns and villages from Tolon –Kunbungu district all in the Northern region of Ghana.

One hundred groundnut farmers were interviewed, using structured questionnaires to document farmers' perception of groundnut diseases, particularly, Cercospora leaf spot diseases. The survey also gathered information on farmers' practices that could affect disease incidence and severity on the field.

Each farmer was interviewed in the local Dagbani language. Out of the one hundred farmers interviewed, 25 were women and the rest men. The questionnaires were self – administered. Statistical Package for Social Scientist (SPSS) version 15.0 was used to analyse the data.

RESULTS

Out of the one hundred groundnut farmers interviewed, Forty seven (47) percent of them reported that ELS and LLS diseases affected about thirty (30) percent of the groundnut plants on their farms, eleven (11) percent of them said ELS and LLS diseases affected about forty (40) percent of the groundnut plants on their farms, forty-one (41) percent of them said fifty (50) percent of the groundnut plants on their farms were lost to ELS and LLS diseases and one percent of the farmers reported that sixty (60) percent of the groundnut plants on their farm were lost to ELS and LLS diseases. Ninety seven (97) percent of the groundnut farmers said they observe ELS and LLS disease symptoms every season and three percent of them said they observe them every year (Table 1). Thus, based on the responses, majority of the farmers were able to indicate the incidence severity of the disease. Assessment of farmers' knowledge of ELS and LLS

Table 1. farmers' perception of the proportion of diseased groundnut plants and disease (ELS and LLS) occurrence

Proportion of diseased groundnut plants on farm	**percent of farmers**
30%	47.0
40%	11.0
50%	41.0
60%	1.0
Disease (ELS and LLS) occurrence	
Every season	97.0
Every year	3.0

Source: field data 2010

Out of the one hundred groundnut farmers interviewed twenty (20) percent of them have been cultivating groundnuts between one to three years, thirty-seven (37) percent of them between four to six years, thirty-six (36) percent of them seven to nine years and seven (7) percent of them have been cultivating groundnuts for over ten years. In all forty-three (43) percent of the groundnut farmers interviewed have been cultivating groundnuts for seven years and above, implying that the farmers had been involved in groundnut production for a considerable number of years (Table 2).

Table 2. Years of groundnut cultivation by farmers interviewed in Tamale and selected towns and villages

Experience of farmers in groundnut cultivation (yr)	Percent of farmers (%)
1-3	20.0
4-6	37.0
7-9	36.0
> 10	7.0

Source: field data 2010

Forty one of the farmers (representing 41%) interviewed, cultivated groundnuts on one hectare or less. In addition, Forty three farmers (representing 43%) cultivated between one and half to two hectares, Fourteen farmers (representing14%) of them between two and half to three and half hectares and two percent of them cultivate four hectares or more every year (Table 3)

Table 3. Hectares of groundnut farms cultivated per farmer interviewed in Tamale and selected towns and villages

Hectares	Percent of farmers
0-1.0	41.0
1.5-2.0	43.0
2.5-3.5	14.0
> 4.0	2.0

Source: field data 2010

Groundnut-based intercropping practices and varieties cultivated by the farmers

Most of the groundnut farmers cultivated groundnuts on the same piece of land year after year. Fifty four (54) percent of the groundnut farmers cultivate groundnut as a sole crop while the rest intercrop groundnuts with maize and guinea corn. Thirty-nine (39) percent of the farmers grow maize in their groundnut farms, two (2) percent intercrop groundnuts with guinea corn and six (6) percent cultivate both maize and guinea corn in their groundnut farms (Table 4).

The groundnut variety, Chinese, is cultivated by eighty (80) percent of the groundnut farmers while twelve (12) percent cultivate Abban and or Chinese and eight (8) cultivate other groundnut varieties. Fifty one (51) percent of the groundnut farmers said they cultivate Chinese because it is marketable, forty (40) percent of them cited early maturity and marketability and nine percent cited early maturity as the reason for cultivating the variety (Table 4).

Table 4. Cropping system, list of intercrops, groundnut varieties grown and reasons for variety choice

Cropping system	Percent of farmers
Sole cropping	54.0
Intercropping	46.0
Intercrops of groundnut	
Maize	39.0
Guinea corn	2.0
Maize and guinea corn	6.0
No intercrop	53.0
Varieties of groundnut cultivated	
Chinese	80.0
Chinese / Abban	12.0
Others	8.0
Reasons for cultivating 'Chinese'	
Matures early	9.0
Marketable	51.0
Matures early and marketable	40.0

Source: field data 2010

Thirty nine (39) out of fifty-four (54) groundnut farmers who cultivate groundnut as a sole crop reported that fifty (50) percent of the groundnut plants on their farms were attacked by both early and late leaf spot diseases, four (4) of them said thirty (30) percent of the groundnut plants, 10 of them said forty (40) percent

while only one (1) farmer said sixty (60) of the groundnut plants on their farms were devastated by the disease (Table 5).

Forty three (43) out of the forty six (46) groundnut farmers who intercrop groundnut with other crops reported that thirty (30) percent of the groundnut plants on their farms were lost to early and late leaf spots, two of them said fifty (50) percent of the groundnut plants and only one (1) farmer said forty (40) percent of groundnut plants on their farms were lost to both early and late leaf spot diseases (Table 5).

Table 5. Effect of cropping system on diseases (ELS and LLS) observed by farmers

Proportion of diseased groundnut plants on farm	Response of farmers who practiced sole cropping	Response of farmers who practiced intercropping	Total
30%	4.0	43.0	47.0
40%	10.0	1.0	11.0
50%	39.0	2.0	41.0
60%	1.0	0.0	1.0
Total	54.0	46.0	100

Source: field data 2010

Perceived constraints by the groundnut farmers

Seventy nine (79) percent of the groundnut farmers perceived early and late leaf spots as major constraint while twenty (21) percent of them reported that it was the combination of early and late leaf spot diseases and lack of credit to meet the cost of production that are major constraints to groundnut production within the area. All the groundnut farmers interviewed agreed that they encountered the early and late leaf spot diseases on their fields (Table 6).

Table 6. Farmers' problems associated with groundnut cultivation in the areas surveyed

Groundnut Problems	Percent of farmers
Disease (ELS and LLS)	79.0
Disease (ELS and LLS) and credit	21.0

Source: field data 2010

Sixty five (65) percent of the groundnut farmers were able to identify some leaves with either ELS or LLS symptoms or both while thirty five (35) percent of them identified and showed a whole defoliated plant with early and late leaf spots (Table 7).

Ninety (90) percent of the groundnut farmers said they see the leaf spot disease symptoms after flowering, seven (7) percent of them said before flowering and three (3) percent of them said at flowering stage (Table 7).

All the groundnut farmers interviewed do nothing to control early and late leaf spot diseases (Table 7).

Table 7. Farmers' knowledge of disease (ELS and LLS), symptoms appearance and disease (ELS and LLS) intervention

Disease sample	Percent of farmers
Leaves	65.0
Whole plant	35.0
Symptom appearance	
Before flowering	7.0
At flowering	3.0
After flowering	90.0
Disease (ELS and LLS) intervention	
No intervention	100.0

Source: field data 2010

Almost all the farmers cultivate groundnuts on the same piece of land year after year. Forty-four (44) percent of them said they lost thirty (30) percent of groundnut plants on their farms to early and late leaf spot, eleven (11) percent of them said forty (40) percent of groundnut plants, forty one (41) percent of them said fifty (50) percent of groundnut plants on their farms and only one (1) percent of them said sixty (60) percent of groundnut plants on their farms (Table 8).

Only three (3) percent farmers said every year they cultivate groundnut at different places. All of them said they lost thirty (30) percent of groundnut plants on their farms to early and late leaf spot (Table 8)

Table 8. Effect of cropping system on diseases (ELS and LLS) observed by farmers

Proportion of groundnut plants diseased	Response of farmers who practiced continuous cropping	Response of farmers who practiced land rotation	Total
30%	44.0	3.0	47.0
40%	11.0	0.0	11.0
50%	41.0	0.0	41.0
60%	1.0	0.0	1.0
Total	97.0	3.0	100.0

Source: field data 2010

DISCUSSION

Fifty three percent of the groundnut farmers lost between 40% - 60% of their farms to both early and late leaf spot diseases. This situation is consistent with observation by Tsigbey (1996) who stated that seed yield loss from leaf spot alone occurred in more than 40% of yield potential of groundnut in northern Ghana. Pod loss due to *Cercospora* leaf spot (ELS and LLS) was as high as 78% on-farm (Tsigbey *et al*., 2004). Combined infection of both ELS and LLS diseases caused yield losses between 50% - 70%, and adversely affected the quality of the kernel (Mehan and Hong, 1991). Hence, groundnut disease control, aimed at increasing yields, has become imperative in northern Ghana (Brandenburg, 2003). Efficient control of groundnut diseases is a prerequisite to the attainment of food security, poverty alleviation and improved livelihood of farm households (Tsigbey *et al*., 2004).

Almost all the groundnut farmers interviewed encountered both ELS and LLS every season. A similar observation was made by Brandenburg (2003) who stated that, ELS and LLS incidence was 100% in all groundnut growing regions in northern Ghana. One of the most devastating leaf diseases is *Cercospora* leaf spot and the most predominant form is late leaf spot found throughout all locations of Northern Ghana. Nutsugah *et al*., (2007a) also encountered both early and late leaf spot diseases which are widely distributed and occur in epidemic proportions in northern Ghana warranting the need for a resistant or tolerant groundnut variety to the disease.

Land ownership and size of holdings determine the number of fields a farmer has access to and rotation cycles vary between two and nine years (Tsigbey *et al*., 2004). Majority of groundnut farmers have been cultivating groundnuts for between 4 and 9 years.

The fact that areas of land cultivated by groundnut farmers ranged from zero (less than a hectare) to over four hectares of land. This is in consonance with findings that areas of land cultivated by groundnut farmers in the north ranged between less than a hectare to more than 6 hectares (Tsigbey *et al*., 2004).

On the farms, about forty-six (46) percent of the groundnut farmers interviewed mixed groundnut with other crops while the rest had sole groundnut farms. The mixed cropping is a method of crop intensification commonly practiced by traditional farmers in many small farms. The benefits that may be derived from intercropping are many and include maximised land utilization, increased farm profits, better income distribution, better labour use, production of more food crops, reduction of weed growth and cost of weed control and improvement of soil physical characteristics and fertility (Paner, 1975; Mercado *et al*., 1976). Although the yield of peanut could be reduced by 20-30% when intercropped with maize (Obordo and Onia, 1970), the combined productivity of the two crops is 30-50% higher than their monoculture yields (Herrera *et al.,* 1975).

Majority of the groundnut farmers use maize as the main intercrop. This is consistent with the observation made by Tsigbey *et al* (2004) that, the predominant cropping pattern in Northern Ghana is a mixture of cereal/legume because maize is one of the major staple foods. According to Marfo (1997), groundnut is an essential component in the cropping system in Northern Ghana because of its ability to fix nitrogen for associated or subsequent cereal crops. Rao and Mathuva, (2000) also reported that legumes are commonly grown in intercrops because of the nitrogen they make available to other crops, and have been shown to increase maize yields.

Overwhelming majority of the groundnut farmers cultivate 'Chinese' variety because according to Frimpong *et al.,* (2006b) it is the most commercially important cultivar in Northern Ghana. According to the farmers, the 'Chinese' variety matures early and it is also highly marketable. It is erect and has a kernel yield of 1.8 tons/ha (CSIR, 2007).

The diseases (ELS and LLS) were more devastating when groundnut was cultivated as sole crop, compared to where groundnut was intercropped with corn and other crops. A review of studies on intercropping and leaf spot diseases indicated that the general trend is toward less disease incidence in intercrops, compared to

monocrops (Duffie, 2003). It has also been observed that barrier rows of corn between groundnut test plots were very effective at preventing spread of early leaf spot and late leaf spot between adjacent plots (Johnson *et al*., 1986). Therefore the practice of growing other crops together with groundnuts by the farmers reduces the incidence and severity of early and late leaf spots of groundnuts as compared to growing only groundnuts.

The early and late leaf spot diseases were the major problems encountered by majority of the groundnut farmers (79%) interviewed. This is because the disease has been reported to be endemic in all the groundnut production areas, and yield loss close to 100% has forced farmers to abandon harvesting their farms because of poor yields (Tsigbey *et al*., 2004).

All the farmers in the survey area were able to identify and show infected leaves or whole groundnut plant infected with both ELS and LLS. Therefore, they perceived ELS and LLS as disease problem. Ninety (90) percent of the groundnut farmers reported that they observed the disease after flowering. This was so because according to Rao and Murty, (1994) depending on genotype and environment, flowering starts at about 25 days after emergence. However, lesions induced by *Cercospora arachidicola* normally first appear three-four weeks after sowing, *Phaeoisariopsis personata* appearing some two-four weeks later (Allen, 1983). Under ideal conditions, visible ELS symptoms develop six to eight days after infection in favourable conditions, and LLS symptoms can be seen 10 to 14 days after infection (Shokes and Culbreath, 1997).

All the groundnut farmers interviewed do nothing to control early and late leaf spots diseases. This is consistent with the observation made by Tsigbey *et al.,* (2004) that, no form of disease control was practiced by the farmers in Northern Ghana. And according to Naab *et al*. (2005), traditionally, farmers in Northern Ghana do not use any management practices to control leaf spot diseases. Farmers will therefore accept a variety resistant or tolerant to leaf spot diseases

The disease is more devastating where groundnut was cultivated on the same land season after season, compared to where groundnut was cultivated on different pieces of land at different seasons. Gibbons (2002) reported that leaf spot-infected fallen leaves of groundnut carried over the disease to the next crop when groundnut was followed by groundnut on the same land. Groundnut should not follow groundnut, as pods break off and stay behind in the soil with plant residue. And according to Pretorius (2006), the fungi may over-winter on these materials and provide inocula in the following season. The practice of growing groundnuts on the same piece of land year after year by farmers in Northern Ghana increases the incidence and severity of early and late leaf spots of groundnuts.

CONCLUSION AND RECOMMENDATION

From the study, farmers perceived both early and late leaf spot diseases as major constraints to groundnut cultivation in Northern Ghana and farmers could easily identify the disease. The study has also revealed that the cultivation of groundnuts as a sole crop on the same land year after year makes the early and late leaf spots more devastating than in situations where groundnut is cultivated with other crops or rotated from one place to another. Farmers in Northern Ghana do not have any solution to the disease problem and are likely to adopt varieties resistant to early and late leaf spot diseases.

It is therefore recommended that farmers should adopt mixed cropping system and also varieties tolerant or resistant to *Cercospora* leaf spots (ELS and LLS) should be developed and released in the area for trials.

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