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Incidence of arthropod pests and diseases of groundnut (*Arachis hypogaea* L.) in northern Ghana

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Abstract
Groundnut (*Arachis hypogaea* L.) is the most popular grain legume crop in Ghana in terms of cultivated area and utilization. Though the bulk of the crop is produced in the Northern Guinea and Sudan savanna zones of the Country yields are marginally low, owing to a variety of abiotic and biotic constraints. Systematic studies on the pest and disease profile of the crop in the area remain scanty, even though preliminary observations suggest that these probably cause appreciable damage to the crop annually. The studies described in this paper were therefore conducted to identify the key pests and diseases associated with the crop, damage caused as well as control measures usually adopted by farmers. Combinations of farmer interviews and direct field sampling were carried out between 2014 and 2015 in five districts viz; Tolon, Savelugu, West Mamprusi in the Guinea savannah as well as in *Bongo* and *Builsa North* in the Sudan Savannah. Most farmers (80%) were able to mention and/or describe the key field pests and diseases often associated with groundnuts in Ghana, with termites, millipedes, white grubs and virus diseases being most frequently mentioned. Inspite of this knowledge, as many as 64% of farmers took no measures to control pests and diseases on their farms. Sampling of farms in the areas largely confirmed the farmer perceptions and responses in terms of the key members of the pest complex. Though many of the observed pests and diseases (especially the foliar ones) proliferated in most farms sampled, the relative abundance scores *(RAS)* showed that their incidence and damage were generally low or moderate. Termites, millipedes and rosette were the exception with *RAS* of over 3.0 on the 1 – 5 scale used, suggesting that these could be of economic importance. These preliminary findings call for more detailed studies to determine the relative importance of the various pests and diseases in groundnut production and to develop and/or disseminate innovations for controlling the economically-damaging ones.

Keywords: diseases, groundnut, arthropod pests, *Arachis hypogaea*

1. Introduction
Groundnut (*Arachis hypogaea* L.) is an important food legume crop in Ghana where it contributes significantly towards food and nutrition security. The nuts are used in soups, pastes, and other household diets where they provide dietary protein of up to 25%, oil/fat (40-50 %), as well as essential vitamins. Groundnuts also contribute to improving soil fertility via biological nitrogen fixation and organic matter returns to the soil and its haulms provide valuable feed for livestock especially during the long dry season.
Like for most of West Africa, groundnut yields in Ghana are marginally low, usually around 1 t/ha compared with the potential of 2.5t/ha. Both biotic and abiotic factors militate against increased and sustainable production of the crop. [1]. reported on the pests and diseases of the crop in the forest and transition zones of the Country but comprehensive studies in Northern Ghana, where the bulk of groundnut is produced, are scanty, even though preliminary observations suggest that these often cause appreciable damage to the crop annually on farmers' fields. The current study was therefore designed to establish the incidence, distribution and relative abundance of the various pests and diseases attacking the crop. Such information would be useful in sensitizing farmers and formulating integrated management strategies for those causing significant damage and yield losses.

2. Materials and methods
The studies which were conducted over a two year period were in two parts namely farmer perception surveys and actual field diagnosis and sampling. Surveys were conducted in five districts of Northern Ghana, three in the Northern region, largely Guinea Savannah (Savelugu, West Mamprusi,Tolon) and two (Builsa North, Bongo) in the Upper east Region (Sudan Savanna) in 2014, to assess farmers' perceptions on pests and diseases as constraints to profitable groundnut production.

In each district, three villages were selected on the advice of the local MoFA extension agents on the basis of history and intensity of groundnut production and 10 – 15 farmers were interviewed using prepared checklists. The checklists sought information on farmers' knowledge of the various pests and diseases associated with their groundnut crops, their perception of the damage caused as well as the control measures they adopted to protect their crops from pests and diseases. Responses were quantified (descriptive statistics) and subjected to ranking to arrive at relative weights given each pest by the farmers. Interviews were conducted just after harvest when experiences from the growing season were still fresh in the minds of respondents.

The second aspect of the study involved sampling groundnut fields in the selected sites for pests and disease infestation. In each district, 5 – 10 of farms, separated by at least 5 km were selected randomly and sampled for pests and diseases using combinations of visual observation, sweep netting and destructive sampling procedures. Data was collected on the identity and relative abundance of pests and diseases as well as the nature and extent of damage where possible. Pest and disease infestation rates were recorded as the percentage of farmer fields in which they occurred, while the within-field occurrences were expressed as relative abundance scores 1 – 5, where 5 =pest/disease occurs in large numbers with visible damage in the field and 1 = pest/disease occurs rarely with no visible damage [2].

3. Results

Farmers were able to mention and/or describe most of the field pests and diseases often associated with groundnuts (Table 1). Of these, the soil-borne arthropods, termites, millipedes and white grubs were the most recognizable. Over 80% of respondents were able to describe each of these as well as the damage they cause to groundnut roots, pegs and pods. Foliar pests of importance mentioned by farmers included aphids, grasshoppers, crickets and leaf-eating caterpillars. Farmers also mentioned a number of diseases attacking their groundnut crops of which 'premature death', root/stem rots, leaf spots and viruses were considered important.

Though largely aware of the damage caused to the crop by pests and disease, majority (64%) of farmers took no conscious actions to control them (Table 2). In cases where farmers took action against pests and diseases, they relied on physical methods, notably *handpicking* (44%) and *rogueing* of affected plants (36%). Spraying the crop with pesticides and treating seed with seed dressers before planting were also mentioned by a few respondents as control options they sometimes applied in their fields. Interesting, a sizeable number of farmers (26%) relied on *spiritual* measures (prayers, sacrifices, festival) to ward off pests and diseases from their farms.

Surveillance and sampling of groundnut fields revealed the presence of all the key pests and diseases recorded on groundnut in Ghana. Of the soil arthropods encountered, white grubs (*Lachnosterna* spp) and millipedes (Myriapoda: Odontopygidae) were the most abundant, infesting over 70% of all farms sampled (Table 3). Termites (*Microtermis spp, Odontotermis spp),* Earwigs *(Forficular spp; Anisolabis spp*) and wireworms (*Gonocephalum spp*.) were the other arthropod pests sampled from groundnut plants and/or the rhizosphere around them. Foliar pests included sap-suckers notably aphids (*Aphis cracivora*), leafhoppers (*Empoasca spp*) and whiteflies (*Bemisia tabacci*) each of which occurred sporadically in at least 65% of all farms sampled. Leaf-eating caterpillars (largely *Heliothis spp*; *Spodoptera spp*) as well as grasshoppers and crickets constituted the main defoliators observed in all farms though their population levels were low and sporadic in most cases. Early leaf spot, caused by *Cercospora arachidicola* and late leaf spot, caused by *Phaeoisariopsis personatum* were observed in 87% of farms, with the latter being more important, especially in the maturing crop, most of which suffered moderate to severe defoliation. These are reportedly the most serious diseases of groundnut worldwide, with yield losses in the range of 10 – 50% (Jackson and Bell 1969). Rosette (both green and yellow) was the main virus disease recorded with the yellow form having the higher incidence across fields and locations.

Relative abundance scores (RAS) presented in Table 4 show that most pests and diseases recorded had low to moderate incidence and damage levels generally below 3 on the 1-5 RAS scale. Termites, millipedes and rosette were the exception with RAS of 3.4, 3.1and 3.0 respectively.

Table 1: Pests mentioned by farmers as damaging their crop

Pest	% farmers mentioning it in each district						
	Savelugu (40)	**W. Mamprusi (35)**	**Builsa North (36)**	**Bongo (40)**	**Tolon (45)**	**mean**	**ranking**
White grubs	82.5	94.3	83.3	72.5	75.6	81.6	3
termites	90.0	80.0	86.1	82.5	77.8	83.3	2
millipedes	100.0	91.4	77.8	82.5	82.2	86.8	1
wireworms	17.5	34.3	38.9	22.5	22.2	27.1	10
aphids	62.5	62.9	77.8	65.0	68.9	67.4	5
leafhoppers	30.0	45.7	55.6	30.0	24.4	37.1	8
defoliators	55.0	51.4	41.7	55.0	42.2	49.1	7
leafspots	57.3	42.9	69.4	65.0	42.2	55.4	6
Virus diseases	85.0	82.9	72.2	60.0	68.9	73.8	4
others	20.0	45.7	33.3	25.0	33.3	31.5	9

Table 2: Control measures usually adopted by farmers to control crop pests including groundnut

Pest	% farmers mentioning it in each district						
Control method	**Savelugu (40)**	**W. Mamprusi (35)**	**Builsa North (36)**	**Bongo (40)**	**Tolon (45)**	**mean**	**ranking**
handpicking	35.0	45.7	38.9	50.0	51.1	44.1	**2**
Rogueing	45.0	37.1	36.1	30.0	3.1	35.9	**3**
Chemical spray	0.0	22.9	16.7	10.0	11.1	12.1	**5**
Seed treatment	2.5	14.3	5.6	5..0	11.1	7.7	**6**
Spiritual	20.0	34.3	22.2	30.0	22.2	25.7	**4**
None	67.5	71.4	83.3	32.5	64.4	63.8	**1**

Table 3: Infestation/infection rate (%) of key pests and diseases observed in groundnut fields in the various districts (2015)

Pest/disease	Savelugu (10)	W. Mamprusi (10)	Builsa North (8)	Bongo (8)	Tolon (10)	Mean	rank
termites	50.0	30.0	37.5	50.0	80.0	49.5	10
White grubs	80.0	80.0	75.0	87.5	80.0	80.5	6
Earwigs	20.0	50.0	37.5	37.5	20.0	33.0	12
Wireworms	20.0	30.0	37.5	62.5	40.0	38.0	11
millipedes	60.0	80.0	62.5	87.5	60.0	70.0	7
Aphids	60.0	70.0	50.0	75.0	70.0	65.0	8
Jassids	90.0	80.0	100.0	100.0	70.0	88.0	1
whiteflies	70.0	80.0	100.0	87.5	80.0	83.5	3
Defoliators	100.0	100.0	100.0	100.0	100.0	100.0	5
Leafspots	90.0	80.0	87.5	87.5	90.0	87.0	2
Rusts	20.0	30.0	12.5	37.5	10.0	22.0	9
Rosette	80.0	60.0	87.5	100.0	90.0	83.3	4

Table 4: Mean Relative Abundance scores (1 -5) of key pests and diseases observed in groundnut fields in the various districts (2015)

Pest/disease	Savelugu (10)	W. Mamprusi (10)	Builsa North (8)	Bongo (8)	Tolon (10)	Mean score	Rank
termites	3.7	3.0	4.0	2.9	3.4	3.4	**1**
White grubs	1.9	1.5	1..8	1.0	1.3	1.5	**5**
Earwigs	1.1	1.0	1.0	1.0	1.0	1.0	**8**
Wireworms	1.1	1.2	1.0	1.5	1.1	1.2	**6**
millipedes	4.5	3.0	3.4	2.1	2.6	3.1	**2**
Aphids	1.7	1.3	1.5	1.5	1.6	1.5	**5**
Jassids	1.5	1.2	1.0	1.0	1.3	1.2	**6**
whiteflies	1.1	1.2	1.0	1.0	1.1	1.1	**7**
Defoliators	1.0	1.0	1.0	1.5	1.1	1.1	**7**
Leafspots	2.1	1.8	2.1	1.5	1.7	1.8	**4**
Rusts	1.0	1.0	1.0	1.0	1.0	1.0	**8**
Rosette	3.0	3.4	2.8	3.1	2.7	3.0	**3**

4. Discussion

The studies clearly showed that farmers are largely aware of the key pests and diseases that attack their groundnut crops annually or occasionally but seldom took measures to control them. Both farmer interviews and field surveys confirmed that peanut is attacked by a complex of soil arthropod pests which cause damage to underground portions of the plant and probably contribute the appreciable yield losses. Similar findings have been reported for the forest and transition zones of the Country [1], suggesting that the pest profile on groundnut is similar in the various agro ecological zones of the country. The results also agree with those of [3] who conducted farmer surveys in Mali, Burkina Faso, Niger, Nigeria, and Benin in West Africa and identified termites, white grubs and millipedes as the most important soil arthropods in peanut. White grubs, millipedes, symphilids, termites and wireworms destroy the roots and termites also cause pod scarification and eat the haulm [4, 5]. The damage caused by the pests lead to loss in grain yield and quality as well as invasion of the kernels by fungi, leading to the production of mycotoxins, including the deadly aflatoxins [6,7,8]. Foliar insects are also of importance in groundnut production, especially the sap-sucking aphids, whiteflies and leaf hoppers. Unfortunately though many farmers were aware of these, they did not clearly appreciate the damage they caused, especially the transmission of virus diseases. Farmers were rather more familiar with the defoliation caused by chewing insects which incidentally may not often lead to economic damage. Similarly many farmers did not appreciate losses that can result from severe leaf spot infection and even confused leaf spot-induced defoliation with signs of maturity. [9]. had earlier reported on the widespread incidence and severity of early and late leafspot diseases in Northern Ghana and advocated that groundnut farmers take control measures against them to sustain yields and profitability.

Though infestation rates of most pests and diseases were high from the field surveys, the relative abundance and damage appeared to be only low to moderate. For instance while defoliators, whiteflies, leafhoppers had infestation rates of over 80%, their *RAS* were usually below 2. There is need for more systematic studies to quantify damage and yield losses and relate these to infestation rates to better guide the need for, and timing of, control actions.

5. Conclusions and recommendations

It can be concluded from the studies that farmers in the study area are largely aware of pests and diseases as constraints to increased groundnut production but lack technical know-how to control them. The field sampling clearly showed that soil arthropods and virus diseases are probably important constraints to groundnut production and detailed studies are required to confirm this and also develop and/or disseminate appropriate innovations for minimizing their damage.

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