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Research Article

An overview of Eight major Groundnut Diseases in Nigeria and their Management

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Abstract

Groundnut is the 13th most important food crop and 4th in oil seed crop of the world. Groundnut seeds (kernels) contain 40-50% fat, 20-50% protein and 10-20% carbohydrates. Groundnut seeds are nutritional source of vitamin E, niacin, falacin, calcium, phosphorus, Magnesium, Zinc, Iron, ribloflavin, thiamine and potassium. One reason for low yields ground nut is the susceptibility of currently grown cultivars to groundnut rosette disease (GRD), the most destructive disease of groundnut. Although rosette epidemics are sporadic, yield losses approach 100% whenever the disease occurs in epidemic proportions. For example, an epidemic in northern Nigeria destroyed approximately 0.75 million hectares of groundnut with an estimated loss ofUS$250 million in regional trade. Other diseases of ground nut that are of economic importance includes, cercospora leaf spot, tikka disease, rust, seedling blight, etc. in this paper, eight major ground nut diseases and their methods of control have been extensively discussed

Keywords: Groundnut, Diseases, Control, Nigeria

INTRODUCTION

Groundnuts (*Arachishypogaea* L) also known as peanuts, earthnuts, gobbers, Pinders, Manila nuts etc (Beghin et *al*., 2003) is a member of the genus *Arachis* in the family *leguminosae* (Fabacaea) which has replaced the traditional Bambara groundnut (*Vigna subterranean*) in many areas of the country (Ashley, 1993). Other members of this family include; Cowpea, Soyabean, Pigeon Pea, Melon etc. Groundnut kernels are consumed directly as raw, roasted or boiled kernels or oil extracted from the kernels is used as culinary oil. It is also used as animal feed (oil pressing, seeds, green materials and straw) and industrial raw material (oil cakes and fertilizer). The uses of groundnut plant make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries (FAO, 2006).

Agriculture which is supplemented by mineral oil remains the panacea to unemployment, poverty alleviation and human development chain and therefore we must go back that way. It is a fact that at the time we had groundnut and Cocoa pyramids our pound was at par with British pound sterling.The agricultural sector's contribution to the Gross Domestic Product (GDP) stood at an average of 56 per cent in 1960-64 declined to 47 percent in 1965-69 and further declined to 35 percent in 2003-2004 (Amaza and Maurice, 2005).

The overall agriculture situation deteriorated creating wide gap between demand for and supply of food. Revenue from the agricultural sector dwindled and the government was faced with mounting food import bills. At the same times, industries continued to import agricultural raw materials, thus overstressing Nigeria's foreign exchange earnings. It was against the backdrop of this rudimentary economy, but abundantly-endowed with human and natural resources, that Nigeria government adopted different agricultural programmesand policies at raising the productivity and efficiency of the agricultural sector. PROTACTA (2007) reported that the performance of Agricultural sector remains below expectations, with over 60% of the population living on less than a dollar a day and another 27% being under nourished.

In response to the dismal performance of the agricultural sector and also to avert eminent starvation due to poverty, various measures have been introduced by successive governments of Nigeria aimed at combating food shortages and poverty. These include among others: National Accelerated Food Production Programme (1972), Operation Feed the Nation (1976). The River Basin and Rural Development Authorities (1976), Green Revolution (1980). Land use Decree (1978), World Bank Assisted Agricultural Development programme (1979 and 1985), Operation Go Back to Land (1984) Directorate of Food Road and Rural infrastructure (1986), Green Revolution (1980) National Fadama Projects (1992), National Agricultural Research Project (1992) National Agricultural Land Development Authority (1991) and The Special programme on Food Security (2001) (Oredipe and Akinwumi, 2002).

However, none of these measures have been able to solve the food problem, since the desired objectives have not been achieved and productivity of food crops has remained low (Nweze, 2002). As a result the rural income is lower today than it was two decades ago and agriculture exports are almost non-existent, thus production techniques have remained rudimentary for the main cropping system despite years of work on technology generation (FMARD, 2001). This wide food deficit has been attributed to resource productivity and efficiency (Onyenwaku, 1987; Okuneye, 1988). The aftermath of this trend has always been gross inability to attain self-sufficiency in food production as the sector became dormant and neglected (Argbokan, 2001).

Groundnut production, marketing and trade served as major sources of employment, income and foreign exchange before Nigeria became independent. The groundnut sector provided the basis for the agro-industrial development and contributed significantly to the commercialization, monetization and integration of the natural rural sector. The objective of this paper is to review some important groundnut diseases and their respective control measures.

EIGHT MAJOR DISEASES OF GROUNDNUT

Tikka disease or cercospora leaf spots

Symptoms

The disease occurs on all above ground parts of the plant, more severely on the leaves. The leaf symptoms produced by the two pathogens can be easily distinguished by appearance, spot colour and shapes. Both the fungi produce lesions also on petiole, stem and pegs. The lesions caused by both species coalesce as infection develops and severely spotted leaves shed prematurely. The quality and yield of nuts are drastically reduced in severe infections.

Plate 1. Late leaf spot Symptoms

Pathogen *C. arachidicola*(Sexual stage: *M. arachidis*)

The pathogen is intercellular and do not produce haustoria and become intracellular when host cells die. The fungus produces abundant sporulation on the upper surface of the leaves. Conidiophores are olivaceous brown or yellowish brown in colour, short, 1 or 2 septate, unbranched and geniculate and arise in clusters.

Conidia are sub hyaline or pale yellow, obclavate, often curved 3-12 septate, 35- 110 x 2.5 - 5.4 µm in size with rounded to distinctly truncate base and sub-acute tip. The perfect stage of the fungus produces perithecia as ascostromata. They are globose with papillateostiole. Asci are cylindrical to clavate and contain 8 ascospores. Ascospores are hyaline, slightly curved and two celled, apical cell larger than the lower cell.

P. personata (C. personata) (Sexual stage: M. berkeleyii)

The fungus produces internal and intercellular mycelium with the production of haustoria. The conidiphores are long, continuous, 1-2 septate, geniculate, arise in clusters and olive brown in colour. The conidia are cylindrical or obclavate,

short, measure18-60 x 6-10µm, hyaline to olive brown, usually straight or curved slightly with 1-9 septa, not constricted but mostly 3-4 septate. The fungus in its perfect stage produces perithecia as ascostromata which are globose or broadly ovate with papillateostiole. Asci are cylindrical to ovate, contain 8 ascospores. Ascospores are 2 celled and constricted at septum and hyaline.

Favourable Conditions

- Prolonged high relative humidity for 3 days.
- Low temperature (20 C) with dew on leaf surface.
- Heavy doses of nitrogen and phosporus fertilizers
- Deficiency of magesium in soil.

Disease cycle

The pathogen survives for a long period in the infected plant debris through conidia, dormant mycelium and perithecia in soil. The volunteer groundnut plants also harbour the pathogen. The primary infection is by ascospores or conidia from infected plant debris or infected seeds. The secondary spread is by wind blown conidia. Rain splash also helps in the spread of conidia.

Management

- Remove and destroy the infected plant debris.
- Eradicate the volunteer groundnut plants.
- Keep weeds under control.
- Treat the seeds with Carbendazim or Thiram at 2g/kg.
- Spray Carbendazim 500g or mancozeb 2 kg or Chlorothalonil 2 kg/ha and if necessary, repeat after 15 days. Grow moderately resistant varieties like ALR 1.

EARLY LEAF SPOT

Plate 2. Early leaf spot: *Cercoporaarachidicola* (Sexual Stage: Mycosphaerellaarachidis)

Symptom

- Lesions are sub-circular in shape and from 1 to over 10mm in diameter
- They are dark brown in colour on the upper leaflet surface where most sporulation occurs and lighter shade of brown on the lower leaflet surface
- The early leaf spot usually has a lighter to dark brown centre and a yellow halo.
- Distribution of fruiting structures is random on upper leaflet surface
- Lesion are also produced on petioles, stems and pegs
- These are oval to elongate in shape and have more distinct margins than the leaflet lesions
- On severity of the diseases, leaflets become chlorotic, then necrotic, lesions coalase and leaflets and shed.

LATE LEAF SPOT

Plate 3. Late leaf spot: *Phaeoisariopsispersonata (Syn: Cercosporapersonata)* (Sexual stage :*Mycosphaerellaberkeleyii*)

Symptoms

- Lesions circular to sub-circular in shape with 1 to 6mm diameter
- All lesions are dark brown to black in colour.
- On the lower leaflet surface where most sporalation occurs the lesions are black in colour and slightly rough in appearance.
- Fruiting structure are in concentric ring on the lower leaflet surface lesions on other parts and effects on disease severity are similar to that of early leaf spots.
- Comparison of early and late leaf spots

Management of early and late leaf spots

- Removal of volunteer groundnut plants and ground keepers and removal or burial of infested crop debris in important in reducing the primary source of infection
- Crop rotation is of primary importance in avoiding early season infection. Grow groundnut and pearl millet in 7:1 ratio
- Time of sowing and plant spacing are important considerations. Where possible there should be a clear break in time between successive groundnut crops
- The early and late leaf spot are effectively controlled by the spray application of cerbendarim 1gm or mancozeb 2gm or hexaconarol 2ml/liter of water at 2-3 weeks interval. 2or 3 times starting from 4-5 weeks after planting
- Cultivate this disease tolerant varieties like vemana and J.C.G-88.
- Crop rotation of cereals-groundnut and burying all groundnut crop residues by deep ploughing will reduce initials inoculums, adjust the data of sowing to avoid conditions favourable for rapid disease development
- Multiple applications of a fungicide such as benomyl, captafol, chlorolhalonil, copper hydroxide, mancorab, or sulphur fungicides may control early and late leaf spot. However, carbendazim (0.058) controls both leaf spots very effectively.
- Three sprays of 0.28 chlorolhalonil at interval of 10-75 days starting 40days after germination up to 90days provides effective control to early and late leaf spot.

RUST

Symptoms

The disease attacks all aerial parts of the plant. The disease is usually found when the plants are about 6 weeks old. Small brown to chestnut dusty pustules (uredosori) appear on the lower surface of leaves. The epidermis ruptures and exposes a powdery mass of uredospores. Corresponding to the sori, small, necrotic, brown spots appear on the upper surface of leaves. The rust pustules may be seen on petioles and stem. Late in the season, brown teliosori, as dark pustules, appear among the necrotic patches. In severe infection lower leaves dry and drop prematurely. The severe infection leads to production of small and shriveled seeds.

Plate 4. Rust – *Pucciniaarachidis*

Symptoms

Pathogen

The pathogen produces both uredial and telial stages. Uredial stages are produced abundant in groundnut and production of telia is limited. Uredospores are pedicellate, unicellular, yellow, oval or round and echinulated with 2 or 3 germpores. Teliospores are dark brown with two cells. Pycnial and aecial stages have not been recorded and there is no information available about the role of alternate host.

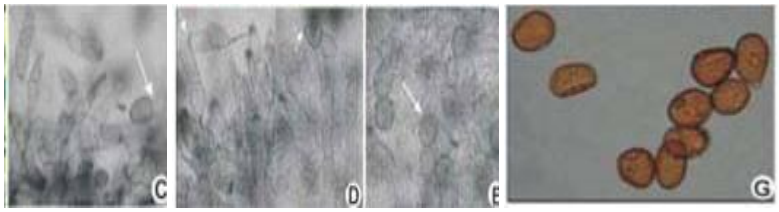

Plate 5. Teliospores Uredospores

Favourable Conditions

- ❖ High relative humidity (above 85 per cent).
- ❖ Heavy rainfall.
- ❖ Low temperature (20-25˚C).

Disease cycle

The pathogen survives as uredospores on volunter groundnut plants. The fungus also survives in infected plant debris in soil. The spread is mainly through wind borne inoculum of uredospores. The uredospores also spread as contamination of seeds and pods. Rainsplash and implements also help in dissemination. The fungus also survives on the collateral hosts like *Arachismarginata, A. nambyquarae* and *A. prostrate*.

Management

- ❖ Avoid monoculturing of groundnut.
- ❖ Remove volunteer groundnut plants and reservoir hosts.
- ❖ Spray mancozeb 2 kg or Wettable Sulphur 3 kg or Tridemorph 500ml or Chlorothalonil 2 kg/ha.
- ❖ Grow moderately resistant varieties like ALR 1.

COLLAR ROT OR SEEDLING BLIGHT OR CROWN ROT

Collar rot or seedling blight or crown rot - *Aspergillusniger* and *A. pulverulentum*

Symptoms

The disease usually appears in three phases.

i. **Pre-emergence rot**

Seeds are attacked by soil-borne conidia and caused rotting of seeds. The seeds are covered with black masses of spores and internal tissues of seed become soft and watery.

ii. **Post-emergence rot**

The pathogen attacks the emerging young seedling and cause circular brown spots on the cotyledons. The symptom spreads later to the hypocotyl and stem. Brown discoloured spots appear on collar region. The affected portion become soft and rotten, resulting in the collapse of the seedling. The collar region is covered by profuse growth of fungus and conidia and affected stem also show shredding symptom.

iii. **Crown rot**

The infection when occurs in adult plants show crown rot symptoms. Large lesions develop on the stem below the soil and spread upwards along the branches causing drooping of leaves and wilting of plant.

Plate 6. Collar rot or seedling blight or crown rot - *Aspergillusniger* and *A. pulverulentum*

Pathogen

The mycelium of the fungus is hyaline to sub-hyaline. Conidiophores arise directly from the substrate and are septate, thick walled, hyaline or olive brown in colour. The vesicles are mostly globose and have two rows of hyaline phialides viz., primary and secondary phialides. The conidial head are dark brown to black. The conidia are globose, dark brown in colour and produce in long chains.

Favourable Conditions

- Deep sowing of seeds.
- High soil temperature (30-35˚ C).
- Low soil moisture.

Disease cycle

The pathogens survive in plant debris in the soil, not necessarily from a groundnut crop. Soil-borne conidia cause disease carry over from season to season. The other primary source is the infected seeds. The pathogen is also seed borne in nature.

Management

- Crop rotation.
- Destruction of plant debris.
- Remove and destroy previous season's infested crop debris in the field
- Seed treatment with Trichodermaviride/ T.harzianum @ 4 g/kg of seeds and soil application of Trichodermaviride/ T.harzianum at 2.5kg/ha, preferably with organic amendments such as castor cake or neem cake or mustard cake @ 500 kg/ ha.

ROOT ROT

Root rot - *Macrophominaphaseolina*

Symptoms

In the early stages of infection, reddish brown lesion appears on the stem just above the soil level. The leaves and branches show drooping, leading to death of the whole plant. The decaying stems are covered with whitish mycelial growth. The death of the plant results in shredding of bark. The rotten tissues contain large number of black or dark brown, thick walled sclerotia. When infection spreads to underground roots, the sclerotia are formed externally as well as internally in the rotten tissue. Pod infection leads to blackening of the shells and sclerotia can be seen inside the shells.

Pathogen

The fungus produces hyaline to dull brown mycelium. The sclerotia are thick walled and dark brown in colour.

Favourable Conditions

- Prolonged rainy season at seedling stage and low lying areas.

Disease cycle

The fungus remains dormant as sclerotia for a long period in the soil and in infected plant debris. The primary infection is through soil-borne and seed-borne sclerotia. The secondary spread of sclerotia is aided by irrigation water, human agency, implements and cattle etc.

Management

- Treat the seeds with thiram or carbendazim 2g/kg or Trichodermaviride at 4g/kg.
- Spot drench with Carbendazim at 0.5 g/lit.

GROUNDNUT BUD NECROSIS DISEASE

Groundnut bud necrosis disease - Groundnut bud necrosis virus (GBNV- Tospo virus)

Symptoms

First symptoms are visible 2-6 weeks after infection as ring spots on leaves. The newly emerging leaves are small, rounded or pinched inwards and rugose with varying patterns of mottling and minute ring spots. Necrotic spots and irregularly shaped lesions develop on leaves and petioles. Stem also exhibits necrotic streaks.

Plate 7. Groundnut bud necrosis disease - Groundnut bud necrosis virus (GBNV- Tospo virus)

Symptoms

Plant becomes stunted with short internodes and short auxillary shoots. Leaflets show reduction in size, distortion of the lamina, mosaic mottling and general chlorosis. In advanced conditions, the necrosis of buds occurs. Top bud is killed and necrosis spreads downwards. Drastic reduction in flowering and seeds produced are abnormally small and wrinkled with the dark black lesions on the testa.

Pathogen

It is caused by Groundnut bud necrosis virus (GBNV). The virus particles are spherical, 30 nm in diameter, enveloped, ssRNA with multipartite genome.

Disease cycle

The virus perpetuates in the weed hosts viz., Bidenspilosa, Erigonbonariensis, Tagetesminuta and Trifoliumsubterraneum. The virus is transmitted by thrips viz., Thripspalmi, T. tabaci and Frankliniella sp.

Management

Adopt plant spacing of 15x15 cm.
Remove and destroy infected plants up to 6 weeks after sowing.
Application of Monocrotophos 500 ml/ha, 30 days after sowing either alone or in combination with AVP (Anti Viral Principle) extracted from sorghum or coconut leaves. Spray the crop with 10 per cent AVP at 500 lit/ha, ten and twenty days after sowing.

ROSSETTE DISEASE

Rossette - Groundnut rosette assistor virus (GRAV), Groundnut rosette virus and Groundnut rosette satellites

Symptoms

The affected plants are characterized by the appearance of dense clump or dwarf shoots with tuft of small leaves forming in a rosette fashion. The plant exhibits chlorosis and mosaic mottling. The infected plants remain stunted and produce flowers, but only a few of the pegs may develop further to nuts but no seed formation (Yayock *et al*., 1976).

Plate 8. Rossette - Groundnut rosette assistor virus (GRAV), Groundnut rosette virus and Groundnut rosette satellites

Pathogen

The disease is caused by a complex mixture of viruses viz., Groundnut rosette assistor virus (GRAV), Ground nut rosette virus and Groundnut rosette satellites is an isometric, not enveloped and 28nm diameter (reported from India) and it gives no overt symptom in groundnut. Groundnut rosette virus is with ssRNA genome, which becomes packaged in GRAV various and thus depends on it for aphid transmission, but produces no overt symptoms in groundnut. The groundnut rosette satellites are satellite RNAs that control the symptoms and cause the different types of rosette (chlorotic, green and mosaic).

Disease Cycle

The primary source of spread by aphid vector, Aphis craccivora and A. gossipii in a persistent manner, retained by vector but not transmitted congenitally. The virus is not transmitted by any other means like mechanical or seed or pollen. The virus can survive on the volunteer plants of groundnut and other weed hosts.

Management

- ❖ Practice clean cultivation.
- ❖ Use heavy seed rate and rogue out the infected plants periodically.
- ❖ Spray Monocrotophos or Methyl demeton at 500 ml/ha.

CONCLUSION

Groundnut rosette virus has been a major preoccupation among groundnut farmersand scientists in sub-Saharan Africa since the mid-1920s. More concerted efforts arerequired to create a situation where available rosette resistance and management packagescan be put into practice. Resistance to GRAV is not currently available in cultivatedgroundnut, but immunity has been found in wild Arachis. This provides an opportunityto transfer resistance in GRAV into cultivated groundnut through conventional and/orbiotechnological approaches. Therefore all resistant material needs to be evaluated forperformance against a range of variants of groundnut rosette disease agents in differentenvironments. Resistance to the aphid vector is a strategy being pursued in breedingfor resistance. Understanding the epidemiological principles of the disease combinedwith resistance will lead to the development of sustainable integrated disease managementstrategies.

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