

Peanut CRSP Breeding program in Uganda *10 years of progress*

David Okello Kalule
Plant Breeder-Geneticist

National Semi-Arid Resources Research Institute



NATIONAL
AGRICULTURAL
RESEARCH
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NaSARRI

- One of the public agric. Research institutes in Uganda – dry land agriculture
- Under NARO
- Groundnut programme most active in EA region



- ✓ *G-nut very important legume in Uganda – 99% consumption*
- ✓ *Protein and oil source*
- ✓ *Income source to rural communities*

Why PEANUT CRSP IN Uganda?

Breed high yielding disease resistant varieties for farmers

Rosette dzz; leafspot; drought resistance, landraces improvements



Disseminate high value seeds

Support national germplasm bank

Enhance G-nut research capacity

*Promote Valencia varieties **for niche market***

Improve livelihoods of groundnut farmers

What we are doing

- **Breeding**

- high yielding
- rosette resistance
- drought tolerance
- early maturity
- Confectionary qualities
- Gnut germplasm assembly – ICRISAT, USDA

- **Socio-economic studies**

- Seed systems survey
- Economics of gnut



Grow new HIGH YIELDING Groundnut varieties

SERENUT SR	CHARACTERISTICS	SERENUT GT
2010	Release date	2010
2500-5000 kg/ha	Yield	2500-3000 kg/ha
105 days	Maturity	95 days
Red	Seed colour	Red
medium	Seed size	large
Resistant to leafspot diseases	Resistant to leafspot diseases	Moderate Resistance to leafspot diseases
Resistant to rosette virus	Resistant to rosette virus	Resistant to rosette virus
85%	Shelling percentage	85%
42%	Crude Fat content	41%
42%	Crude Protein	32%
Easy	Ease of shelling	Easy
Slight	Pod Beak	Slight
Confectionary, Butter, snack, sauce	Recommended uses	Confectionary, Butter, snack, sauce
Countrywide	Cultivation regions	Countrywide



For seed and agronomy details, contact: Groundnut Programme, He2000, Etwate, Tel: +254 054 463462, +254 752887168, email: hani@cgiar.com



What we are doing

- **Capacity building**
 - Laboratory infrastructure
 - Farmer training; staff capacity;
 - Graduate training
- **Outreach to farmers**
 - Fact sheets
 - Production guides
 - Disease manuals
 - Demonstrations / fields days
 - Annual agriculture shows





Onfarm yield trial



What have we achieved with P-CRSP?



Groundnut Varieties Released in Uganda between 1966-2011

Okello, D.K., NaSARRI Groundnut Department: kod143@gmail.com; kod143@yahoo.com; 0712858768/0753858768

Variety	Maturity (Days)	Yield (kg/ha)	Year of Release	Other Remarks
Red Beauty ¹	90-100	1900-2500	1966	Multiline of Red Valencia
Acholi white ²	80-90	1900-2500	1966	Valencia, off white
Roxo ²	100-110	2000-2700	1969	Red Manyema, Venezuela
Tatu ²	100-110	1900-2400	1969	Spanish
Manipintar ²	110-120	2600-3600	1969	Virginia
Bukene ²	90-100	1800-2600	1970	Spanish
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Makulu Red ²	110-120	2000-2800	1970	Virginia, red seeded
Amasoga ²	110-120	1800-2300	NA	Local
Igola - 1 ²	125-130	3000-3500	1995	Virginia, striped
Serenut 1R ²	100-110	2500-3700	1998	Virginia, Red Seeded
Serenut 2 ²	100-110	2500-3500	1998	Virginia, Tan
Serenut 3R ²	90-100	2500-2900	2002	Spanish, Red seeded
Serenut 4T ²	90-100	2500-2900	2002	Spanish, Tan seeded
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Serenut 6T	90-100	2500-3000	2010	Spanish, Tan seeded
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Serenut 12R	100-110	2500-3700	2011	Virginia, Red seeded
Serenut 13T	100-110	2500-3700	2011	Virginia, Tan seeded
Serenut 14R	100-110	2500-3700	2011	Virginia, Red seeded



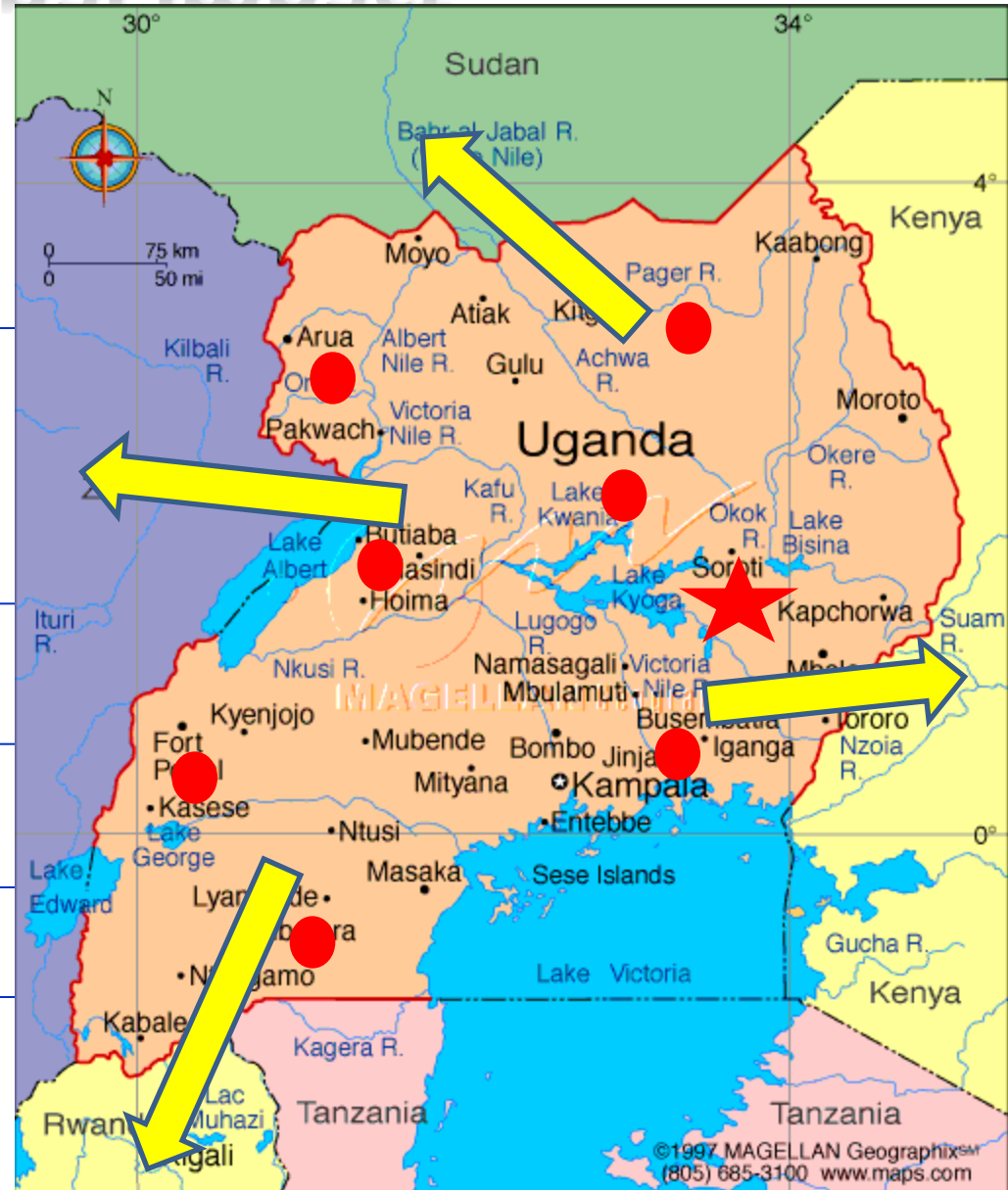
- ✓ Increased incomes among beneficiary farmers – impact study
- ✓ New varieties (14)– higher production
- ✓ Enhanced Germplasm: USA; ICRISAT, hybridization; >700
- ✓ Increased R4D capacity: 7 scientists; >10 technicians; 1 lab; 1 Truck; 1 weather hawk, 3 computers, 15 tally counters, 2GPS handsets, 2 hybridization kits; etc

✓ Disseminated info materials: >10 Papers; 5 drafts; 2 Manuals; 10 posters and 5 fact sheets

✓ National and International recognition: GoU (MAAIF; NARO; NAADS); TL2; AGRA; Carnegie , EU-IFAD (ICRISAT)

Regional impact

- ✓ Only active groundnut breeding research station in Eastern Africa serving Rwanda, DRC, Sudans, Kenya, Tanzania, Burundi
- ✓ Seed/varieties shared with South-Sudan, Sudan, Ethiopia, Mozambique, Ghana, Ivory Coast, Sierra Leone, (CAR awaiting permit)
- ✓ 3 Rosette Virus hotspot
- ✓ Leafminer Hotspot
- ✓ Training G-nut Breeder for Southern Sudan



PCRSP in Uganda!

- Increased visibility and importance of gnut programme in region and globally:
- Published research foundation paper: overview of groundnut research in Uganda, Past, Present and Future

African Journal of Biotechnology Vol. 9(39), pp. 6448-6459, 27 September, 2010
Available online at <http://www.academicjournals.org/AJB>
ISSN 1684-5315 © 2010 Academic Journals

Review

Overview of groundnuts research in Uganda: Past, present and future

D. K. Okello^{1*}, M. Biruma¹ and C. M. Deom²

¹Groundnut breeding Department, National Semi-Arid Research Resources Institute, P.O Box Soroti, Uganda.

²Department of Pathology at the University of Georgia, University of Georgia, Miller Plant Sciences Building, Athens 30602.

Accepted 18 March, 2010

Featured in Daily monitor Newspaper, 27/2/2013






<http://www.monitor.co.ug/Magazines/Farming/New-groundnut-varieties-perform-to-expectations/-/689860/1705536/-/klv2ba/-/index.html>

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New groundnut varieties perform to expectations

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On this 28th Day of February 2012

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to

Kalule Okello David

In appreciation for your **Outstanding Performance as a Scientist in NARO**

F. I. B. Kayanja

Professor Frederick I.B. Kayanja
CHAIRMAN, NARO GOVERNING COUNCIL

International: Science career magazine: Plant Geneticist Cultivating a Future for Peanut Farming in Uganda.

The screenshot shows the Science Careers website interface. At the top, there's a navigation bar with 'Science' logo, 'AAAS.ORG', 'FEEDBACK', 'HELP', 'LIBRARIANS', a search box, and 'SEARCH' and 'ADVANCED' buttons. Below that is a red navigation bar with 'NEWS', 'SCIENCE JOURNALS', 'CAREERS', 'BLOGS & COMMUNITIES', 'MULTIMEDIA', 'COLLECTIONS', and 'JOIN / SUBSCRIBE'. A secondary navigation bar includes 'Help', 'Meetings & Events', 'About Science Careers', and 'Contact'. The main navigation bar has 'Career Magazine', 'My Science Career', 'Find A Job', 'Graduate Programs', 'Tools & Tips', 'Community', and 'For Employers'. Below this is a sub-navigation bar with 'Issues & Perspectives', 'Career Advice', 'The Job Market', 'Career Profiles', 'Life & Career', and 'Diversity Issues'. The breadcrumb trail reads: 'Science Home > Science Careers > Career Magazine > Previous Issues > 2010 > February 12'. The article section features a search bar, a photo of hands holding a peanut (captioned '(Nick Pattinson)'), the title 'Plant Geneticist Cultivating a Future for Peanut Farming in Uganda', the author 'By Gaia Vince', and the date 'February 12, 2010'. The article text begins: 'David Kalule Okello heads up a national research program, yet he earns less than \$6000 per year. He's continually frustrated by the poor lab facilities and paucity of science funding in Africa, yet he won't consider working in the United States or in Europe. He has lived through three civil wars, yet he's only 33. Despite these extraordinary circumstances, Okello is one of East Africa's most promising weapons in the battle against hunger.' A quote from David Kalule Okello is displayed: 'Our professor used to tell us: 'Look at the doctors; they cannot treat patients if they themselves are hungry. Look at the patients; they cannot recover unless they have food. Look at the lawyers. ... Without food nobody can work, and you are the guys that can provide it.' --David Kalule Okello'. On the right side, there are two advertisements: one for 'Ardipithecus ramidus' and another for 'eppendorf & Science PRIZE FOR NEURO BIOLOGY'.

- http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2010_02_12/caredit.a1000016
- Ranked 3rd overall best article 2010
- <http://community.sciencecareers.org/ctscinet/articles/2010/12/the-best-of-science-careers-2010.php>

New crop varieties can increase net income by US\$130–254 /ha and cut poverty 7–9%

varieties can cut x

www.scidev.net/en/agriculture-and-environment/news/new-crop-varieties-can-cut-poverty-study-finds.html

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New crop varieties can cut poverty, study finds

Bernard Appiah
3 January 2012 | EN | FR

The thorny question of whether improved crop varieties do, in fact, lift peasant farmers out of poverty has been answered positively in a study of groundnut varieties, according to researchers at the International Maize and Wheat Improvement Center (CIMMYT), in Kenya.

Evidence that new technologies improve small farmers' wellbeing is scarce because the impact of adopting technologies depends on many factors such as the existence of infrastructure, policies and institutions that are often not fully functional in developing countries. For example, technology that increases productivity may not reduce poverty if the farmers do not have access to markets to sell their extra crop.

In addition, some studies have claimed that building capacity is more important than technology for improving livelihoods.



The new groundnut varieties are resistant to major pests and diseases
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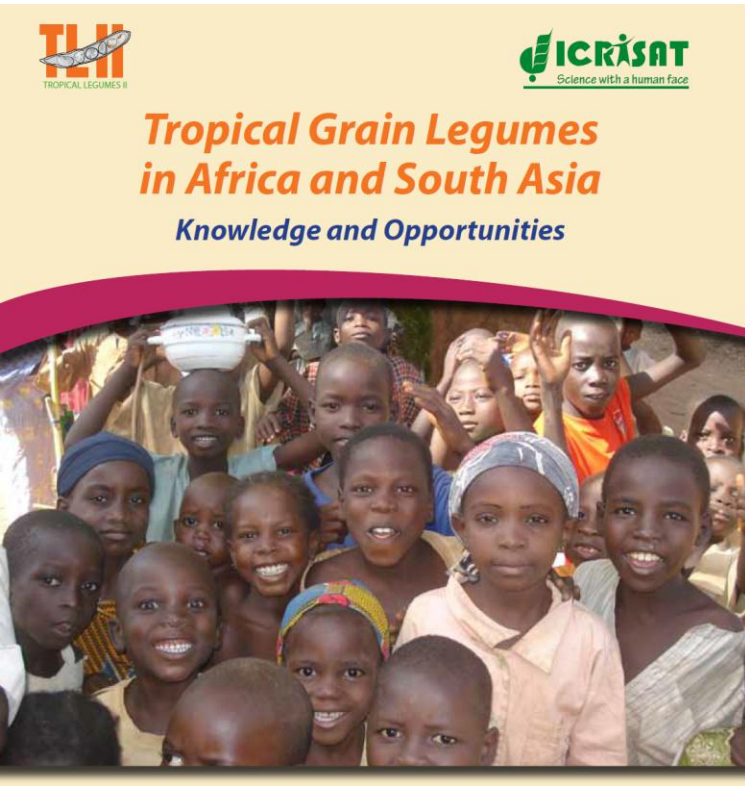
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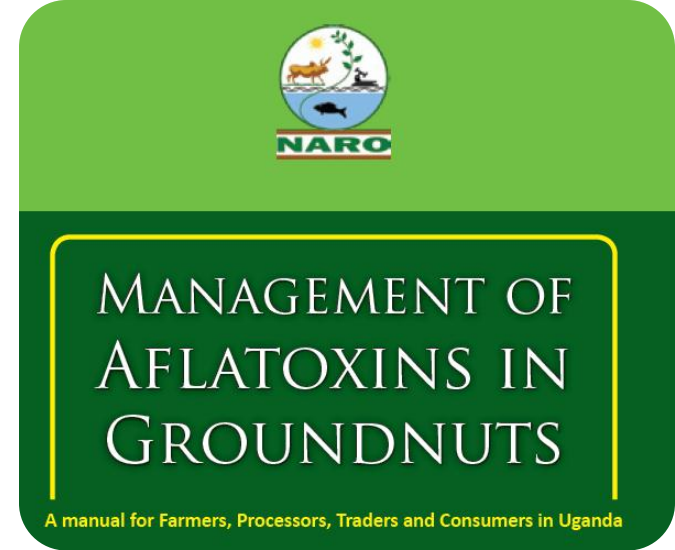
Co-wrote **Groundnut Trait Dictionary** being used by Generation challenge Programme legumes grantees. This database was used to develop a data collection and management tool called integrated-breeding-platform




Books



International Crops Research Institute for the Semi-Arid Tropics.
112 pp. ISBN: 978-92-9066-544-1. Order Code: BOE 056.



<http://www.naro.go.ug/Information/narodocuments/groundnut%20aflatoxin%20mgt%20manual%20Uganda.pdf>



Bulletin of Tropical Legumes

A MONTHLY PUBLICATION OF THE TROPICAL LEGUMES II PROJECT

14
Feb
2012

About the Bulletin

The Bulletin of Tropical Legumes is a monthly publication of the Tropical Legumes II (TL II) project, funded by the Bill & Melinda Gates Foundation, and jointly implemented by the International Crops Research Institute in the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT) and the International Institute of Tropical Agriculture (IITA) in close collaboration with partners in the National Agricultural Research Systems of target countries in Sub-Saharan Africa and South Asia. TL II aims to improve the livelihoods of smallholder farmers in drought-prone areas of the two regions through enhanced grain legumes productivity and production.

Grain legume	Central	Eastern	Northern	Western
Common bean	26.0	21.4	10.0	42.5
Groundnut	20.2	25.1	21.1	33.7
Pigeonpea	0.0	20.0	77.1	2.9

Distribution of grain legumes in Uganda (values are percentages)

Grain Legumes of Uganda

The crops

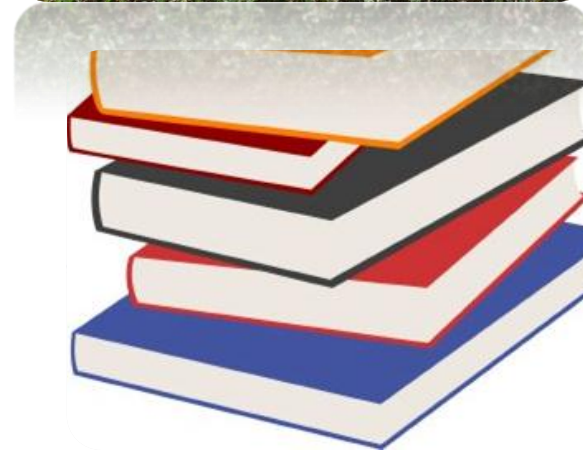
Uganda has rich agro-biodiversity consisting of close to 40 crop species. Plantain, beans, maize, sweet potato, and millet are the dominant crops. Major grain legumes of this country include common bean (*Phaseolus vulgaris*), groundnut (*Arachis hypogaea*), soybean (*Glycine max*), pigeonpea (*Cajanus cajan*), cowpea (*Vigna unguiculata*), field pea (*Pisum sativum*), and chickpea (*Cicer arietinum*), in descending order of importance. These crops collectively account for greater than 20% of the country's more than 7.5 million ha of total cultivated area.

Area planted to major grain legumes showed variable levels of growth (Table 1). Relatively higher rates of growth (ROG) were observed for groundnut, followed by common bean, chickpea, and cowpea; soybean and pea registered a less than 1% growth each.

Yields were lowest for common bean, followed by chickpea and groundnut whereas soybean, cowpea and pigeonpea yields were greater than 1 MT per ha (Table 1). Rates of growth for yield were relatively greater for cowpea than the rest of the crops. Common bean yields fluctuated sharply over the season (Figure 3).

- Attended many **international workshops and trainings**
 - **Trainings:** Short term (Uconn)
 - AAGB (Georgia, Mali)
- **Latest publication:** Thuo, M., Bell, A.A., Bravo-Ureta, B.E., **Okello, D.K.**, Okoko, E.N., Kidula, N.L., Deom, C.M., and Puppala, N. (2013). Social network Structures Among Groundnut Farmers. Journal of Agricultural Economics
DOI:10.1080/1389224X.2012.757244.
- Three manuscripts are near submission.
- **Students Mentoring:** 4MSc completed; 8 ongoing (MAK)
>20 BSc Agric had internship; numerous certificates and diploma students pass thru our programme
- **PhD student** under supervision of Prof Deom (UGA)
- **Books under writeup:**
 - Production manual with Prof Deom UGA (in Print)
 - **Seed production manual:** Prof Boris (Uconn) and ICRISAT Malawi (Final review underway)
 - **Booklet Compendium** on commercial varieties in Uganda (Dr Naveen): In progress

FUTURE RESEARCH DIRECTION



Vision : Center Of Excellence in the Region

- **Varietal development:** Aflatoxin, drought, rosette, leafspots, leafminer deploying complementary novel approaches (MAS, gene silencing, pathogen derived resistances)
- **Continue to Disseminate germplasm** to groundnut growing countries of Sub-Saharan Africa.“
- **Education/Training:** farmers, extension, processors, students
- **Dissemination materials:** books, flyers, factsheets, DVDs
- **Infrastructure:** lab upgrade; training halls



More than collaborators but family

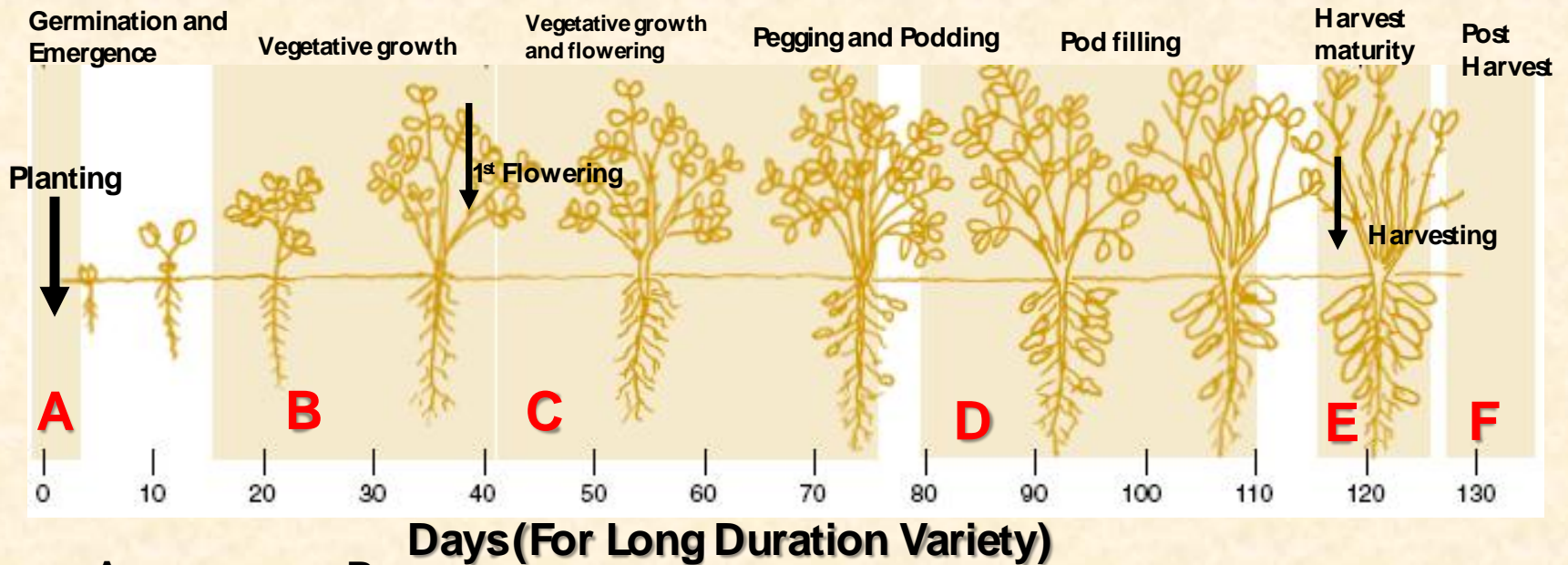


FLYERS

DEVELOPMENT STAGES GROUNDNUT AND RECOMMENDED PRACTICES

Okello .D.K., NaSARRI Groundnut Improvement Programme: kod143@gmail.com; 0712858768/0753858768;

2013



- A**
- > Prepare land early so that seed can be planted early after first rains.
 - > If possible, fertilize with SSP or TSP before planting.
 - > Choose good quality seed.
 - > Dress seed with thiram to control fungal and bacterial growth.
 - > Sow at 5–6 cm depth.
 - > Space at 45 x 7.5–10 cm for bunch type varieties.
 - > Space at 45 x 10–15 cm for Semi-erect type varieties.

- B**
- > Ensure good weed control.
 - > Avoid earthing up plants when using hoe.
 - > Check for aphids or leaf miners and control if necessary.

- C**
- > Ensure good weed control.
 - > Weed by hand pulling to avoid earthing up and damage to pegging.
 - > Check for pests and diseases and control where necessary.

- D**
- > If weeding is required use hand pulling.
 - > Check for pests and diseases and control where necessary.

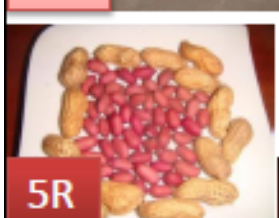
- E**
- > Harvest when 70% or more pods are mature.
 - > Use dark markings on inside of shell.
 - > Seeds should be plump and correct colour for variety.
 - > If crop is severely defoliated (95%) or sprouting has begun, harvest straight away.
 - > Clean excess soil from pods.
 - > Wilt/dry in windrows for 3–5 days.

- F**
- > Dry pods on mats for a further 2–5 days.
 - > If A-frames or cocks used, dry for 3–4 weeks and then pickoff the pods.
 - > Do not dry any further after picking.
 - > Before storing remove poor, damaged, shrivelled, rotten or fungus-infected pods.
 - > Store pods in gunny bags in a cool, dry, well ventilated store.
 - > Do not store moist groundnuts.
 - > Do not use plastic or polyweave bags.

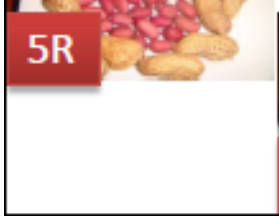
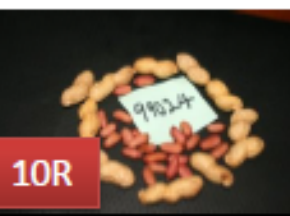
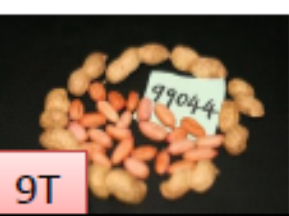
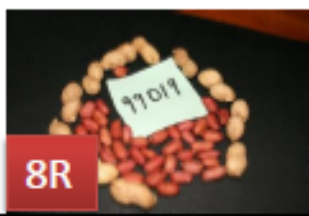
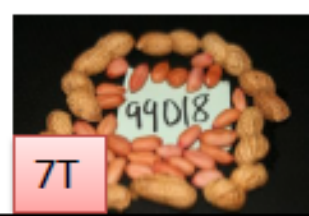
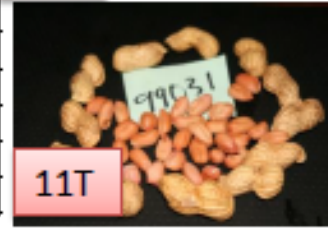
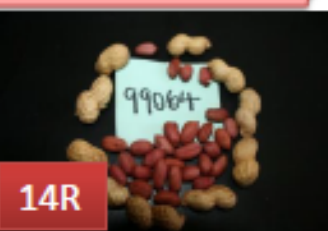
Acknowledgements Peanut CRSP, AGRA, TL2, IFAD-EU, NARO, NaSARRI, All stakeholders

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Early and Late leafspot diseases

The problem

Early leaf spot (*Cercospora arachidicola*) and late leaf spot (*Phaeoisariopsis personatum*) are the most damaging diseases of peanut worldwide. Besides adversely affecting the yield and quality of pod, it also affects the yield and quality of haulm, a popular source of animal feed.

Background

- Although just one leaf spot type usually predominates in a production region, both leaf spot types are generally found in a single field.
- Shifts in leaf spot species also have been observed over a period of years.
- Early leaf spot usually have light to dark-brown centers, and a yellow halo. Spore formation is on the upper surface of leaflets.
- Late leaf spot develops small spots that enlarge and become light to dark brown. The yellow halo is either absent or less visible in late leaf spot. Spore formation is common on the lower surface of leaves.

Management

Cultural control:

- Leave at least 1 year between crops planted on the same land, so that the remains of the old crop decompose before another crop is planted;
- Remove and burn or bury the remains of the crop after harvest.
- Plant new crops as far away as possible from old crops, especially those with leaf spots;
- Do not plant downwind from near old groundnut crops; otherwise, spores will easily spread to the new crop
- Early sowing has been shown to reduce the severity of leafspots. Adjust the date of sowing to avoid conditions favorable for rapid disease development.

Chemical control:

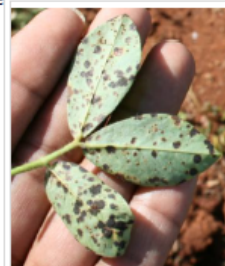
- Carry out regular inspections;
- Multiple applications of a fungicide such as benomyl, captafol, chlorothalonil, copper hydroxide, mancozeb, or sulphur fungicides may control early and late leaf spot. However, carbendazim (0.05%) controls both leaf spots very effectively.
- Three sprays of 0.2% chlorothalonil at intervals of 10–15 days starting 40 days after germination up to 90 days provides effective control to early and late leaf spots, and rust.

Resistant varieties:

Plant resistant varieties such as Serenut 2, Serenut 5R, Serenut 8R, Serenut 10R, Serenut 12R, ICGV-SM 03590, ICGV-SM 02501, ICGV-SM 01510, ICGV-SM 01514, and ICGV-SM 01515. These are available from NARO/NaSARRI Serere; Seed Companies



Early Leafspot disease
Image credit: KOD



Late Leafspot disease
Image credit: KOD



Severely affected groundnut field with leafspots disease
Image credit: KOD

Scientific name ► *Cercospora. Arachidicola* (Early leaf spot) and *Phaeoisariopsis personatum* (Late leaf



Authors: Kalule Okello David, Biruma Moses, Akello Beatrice Mulema Joseph Mary, Carl, M. Jane Ininda, Deom; Naveen Puppala and Boris B. Ureta

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Edited by < Phil Taylor >

PLANTWISE

Groundnut Rosette Disease

Recognize the problem

Groundnut rosette virus disease: is a very serious disease of groundnuts in Uganda. It is spread by aphids feeding on the crop.

Background

- There are two types of symptom seen in the crops: green and yellow both are stunted.
- There is no control once a plant is infected and early infected plants produce no yield
- There is no control for the virus but control of the aphids will prevent further spread

Management

1. **Chemical control:**
 - Spray whole plant with insecticides, such as dimethoate 14 days after emergence (usually 5mls per 2 litres of water but read the label for instructions) and then at 10-day intervals for a total of four sprays.
2. **Cropping practices:**
 - Timely planting as soon as there is enough water in the soil.
 - For erect types (Serenut-4T) plant one and a half feet between rows and half a foot between plants along the row. For spreading types (Serenut 2) plant 3 plants per 2 feet along the row.
 - Intercropping with beans or sorghum is effective in reducing the disease incidence as this confuses the aphids movement.
3. **Host plant resistance:**

Resistant varieties exist such as Serenuts 2-14 series, Igola 1 and are available from NARO/NaSARRI Serere; Seed Companies



Green Rosette Virus. This plant was infected early and will not produce any yield



Yellow Rosette Virus, no yield will come from the infected plant (right).

Scientific name ► *<Groundnut rosette virus disease>*

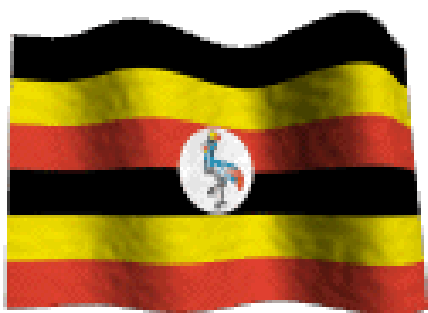
The recommendations in this factsheet are relevant to: Kenya, Sudan, Rwanda, DRC, Tanzania.



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