Status and Availability of Germplasm of Pesticidal Plants

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Introduction

Pesticidal plants – widely used in the tropics, precisely in developing countries

Compared to synthetics, are cheap, available and environment friendly

Extensively reviewed topic;

- ***Online data bases and publications / Projects***
- ***The Wealth of India – A dictionary of Indian Raw Materials and Industrial Products***
- ***Schmutterer, H. 1995. Neem Tree – Source of Unique Natural Products for Integrated Pest Management, Medicine, Industry and Other Purposes.***
- ***Herbarium Vouchers - recorded uses / ethnobotany data; Research Organizations – ICRAF, NMK, RBG KEW, UNIVERSITIES, KALRO - GeRRI***

Examples of some pesticidal plants include

- *Strychnos spinosa* Lam.
- *Securidaca longipedunculata* Fresen.
- *Zanha africana* (Radlk.) Exell (nb Recalcitrant)
- *Lippia javanica* (Burm.f.) Spreng.
- *Solanum incanum* L. ?
- *Zanthoxylum zanthoxyloides* (Lam.) Zepern. & Timler
- *Zanthoxylum heitzii* (Aubrév. & Pellegr.) P.G.Waterman
- *Tephrosia vogelii* Hook.f.
- *Euphorbia tirucalli* L.
- *Lippia javanica* (Burm.f.) Spreng
- *Tagetes minuta* L.
- *Tithonia diversifolia* (Hemsl.) A.Gray
- *Vernonia amygdalina* Delile
- *Ocimum suave*

Approaches to managing pesticidals

……species managed to ensure their sustainable use and restocking for the benefit of present and future generations:

http://www.centerforplantconservation/org/

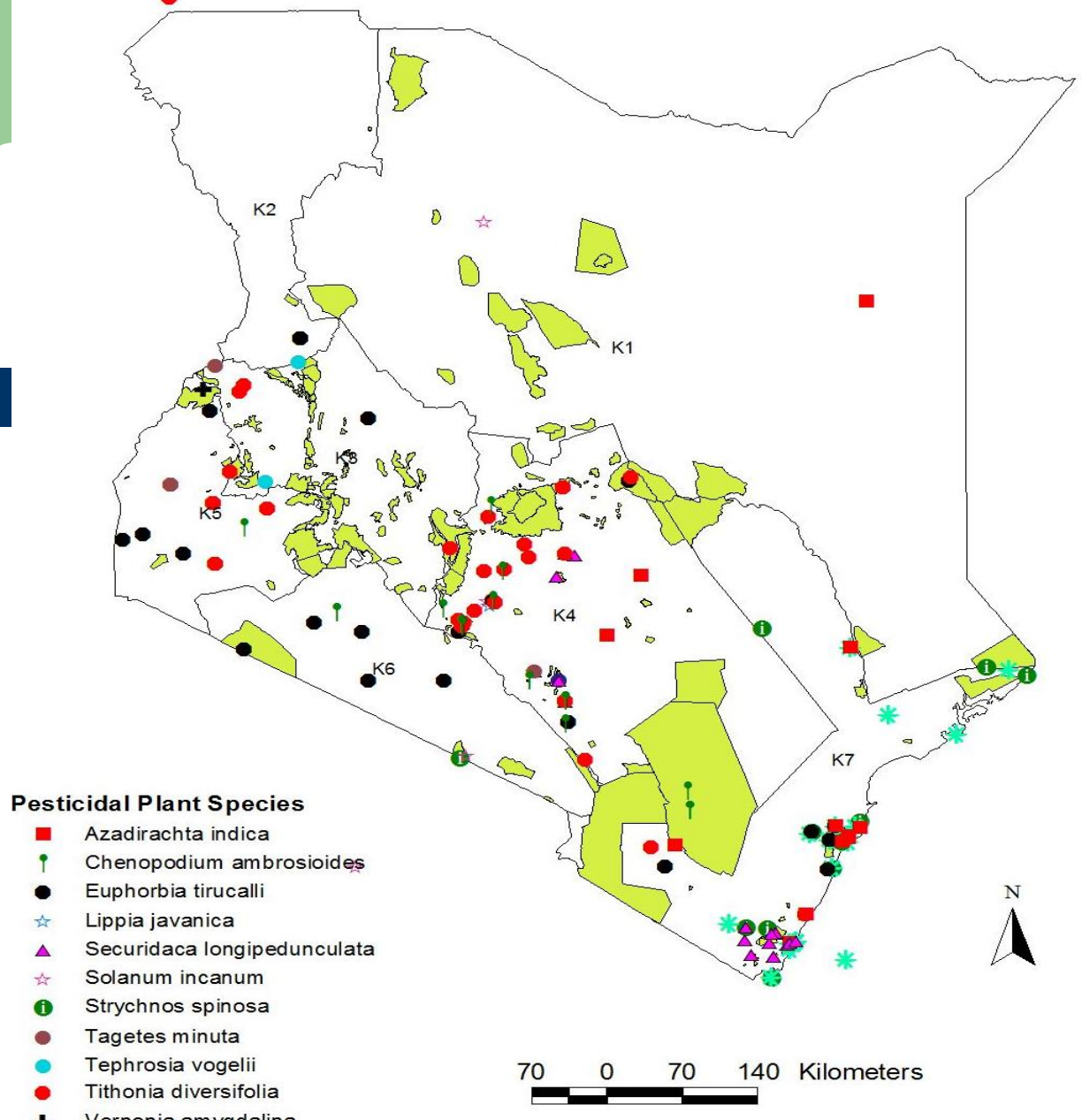
Status of pesticidals

- Site based approaches – Natural habitats (in-situ) where species have evolved **e.g** National parks, forest reserves, national monuments, biosphere reserves, heritage sites, On-farm

Advantages of site based approach

- Allow evolution to continue
- Access to public
- Allow ethno botany to continue
- Allow access for research
- Risks:
  - Prone to political decisions / excisions, expensive to maintain due to extensive terrain
  - Prone to environmental hazards – fires, floods, drought

DISTRIBUTION OF PESTICIDAL PLANTS IN KENYA



Off-site (*ex-situ*) approaches

- Off-site – (*ex-situ*) seed banks, botanic gardens, field genebanks, Arboreta, DNA banks, Invitro / pollen cultures
- Advantages: Secure protection, Allow research to continue
- Risks:
  - Expensive to manage
  - species specific methods
  - Evolutionary static – might ultimately not cope with climate change dynamics

Seed banks – propagule of storage is the seed

- Started at small scale by Vavilov – 1920s – Seeds stored in metal cases under room conditions
- 1974 International Board for Plant Genetic Resources (Bioversity International – stringent conditions)

Desiccation tolerant seeds dried at 15^{o} C /15 % rh

Translates to seeds at 4 -7 % mc

Seeds hermetically sealed and stored at – 20^{o}C

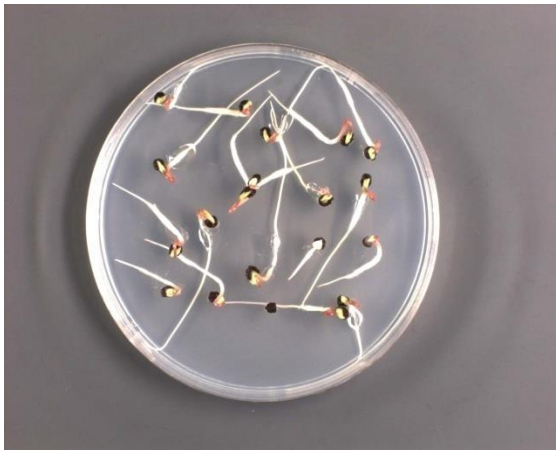
LIFE FOR DECADES +++

- Base collections - long term collections
- Just accessible after war, major catastrophes – Tsunami, Volcanic explosions, floods etc (Others think otherwise)

Seed banks: the Opportunities

Land degradation

Habitat revegetation



E. turicalli germinating in 1 % water agar

Kenya – National genebank

- Started as Prop Plant Genetic Resources Centre
- From 2000 – became PGR Centre – covering other plants
- 2014 – upgraded to semi-autonomous GeRRI
  - Plant, animal including Pollinators, & microbial GR
- GBK has 2 storage cells (cold stores) with a capacity of about 60,000 accessions (+5^{0}C& -20^{0}C)
- Currently there are about 50,000 accessions of over 2200 species conserved at the seed-bank.
- Collections originate from at least 137 countries of the world with over 60% coming from Kenya.
- In addition there also exists several field gene-banks for crops such as Cassava, sweet potato, yam, taro etc:
- Moving to establish botanic gardens and nature sites for botanicals etc

Seed Drying unit

Drying done in muslin bags

- Cold store
- Materials stored in laminated foil packets

Predictions of seed longevity (time for viability to fall by one probit, d) for seeds from four *Euphorbia* species. *Source Muthoka et al 2010.*

Species	emc* Kisumu (% f.wt.)	σ Kisumu 23.7°C (days)	emc* Nairobi (% f.wt.)	σ Nairobi 23.7°C (days)	emc* dry-room (% f.wt.)	Seed bank -20°C (years)
E. heterochroma	7.8	46	8.9	33	3.8	588
E. heterophylla	9.9	98	11.3	98	4.8	206
E. pseudoburuana	9.2	33	10.6	20	4.5	799
E. quinquecostata	7.8	86	8.9	53	3.8	2593

Botanic – Gardens

- Started by medical schools in Europe *ca* 15th Century (e.g Pisa in Italy)
- Scaled by early explorers – plant for commercial use – coffee, palms in the tropics
- 90% in developed countries
- Just evolving in developing countries
- Living collections e.g Nairobi botanic gardens, Entebbe botanic gardens (Uganda), Amani botanic gardens (Tanzania)

Botanic gardens drive international agreements for conservation action

Role of botanic gardens

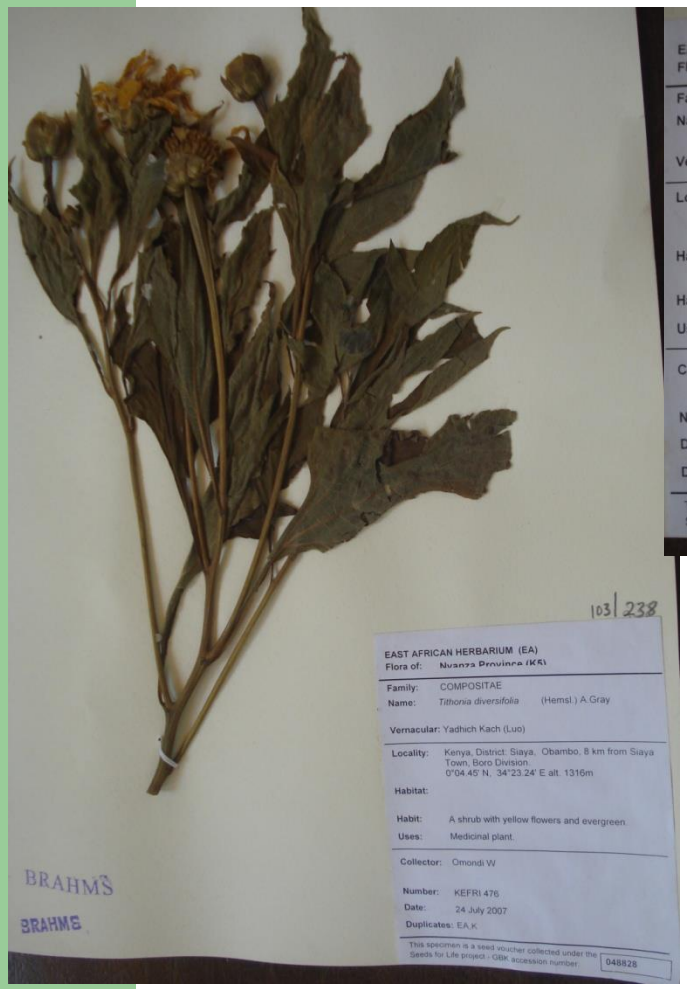
- Documenting plant diversity
- Conserving plant diversity
- Using plant diversity sustainably
- Promoting education and awareness about plant diversity
- Building capacity for the conservation of plant diversity

Botanic gardens vs school

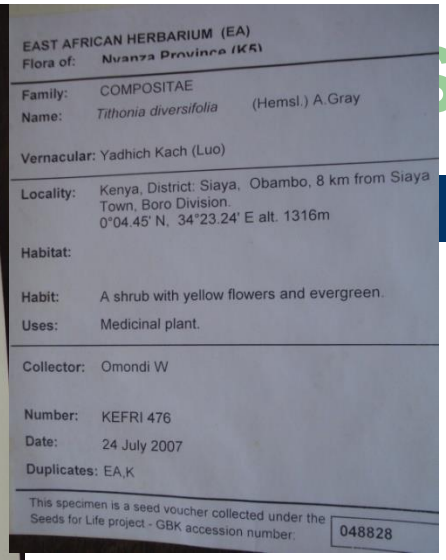
Promoting tree planting and capacity building

Botanic garden collections

Tithonia diversifolia (Hemsl.) A.Gray



Herbarium voucher specimen

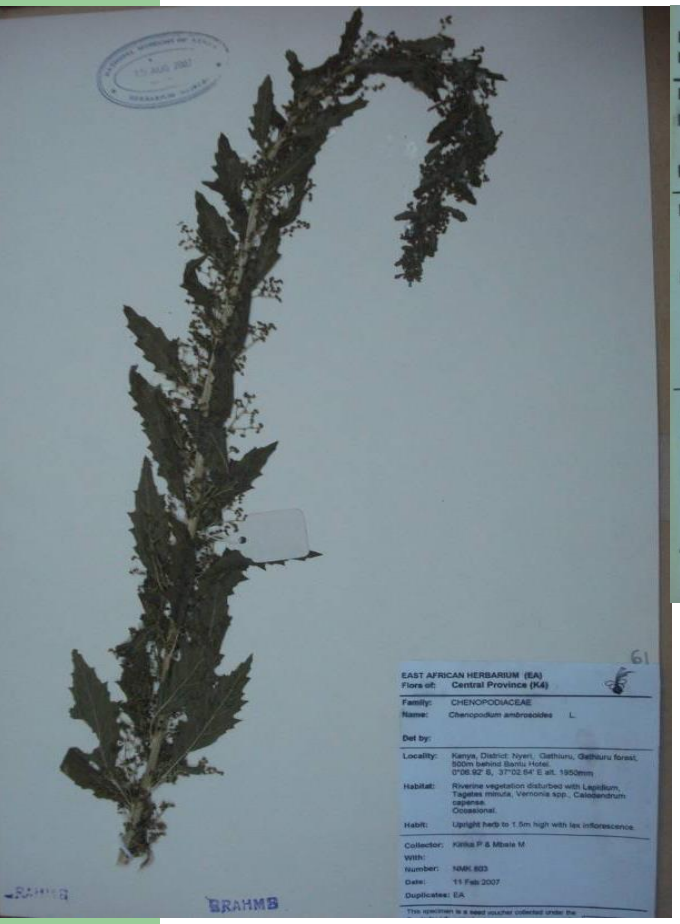


Voucher specimen label

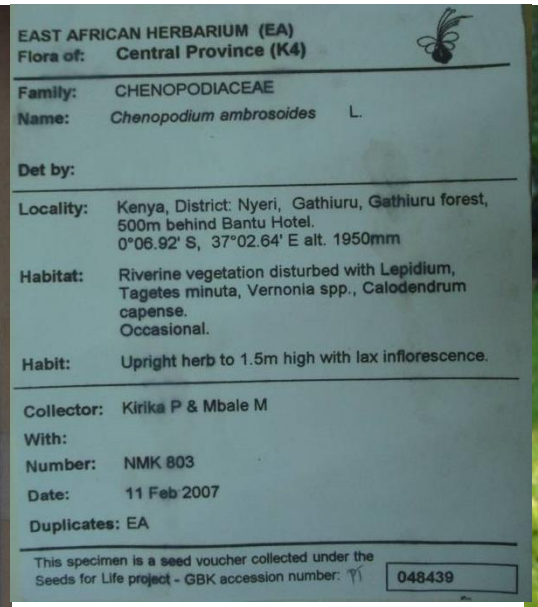
NMK botanic garden

Botanic garden collections

Chenopodium ambrosioides L.



Herbarium voucher specimen



Voucher specimen label

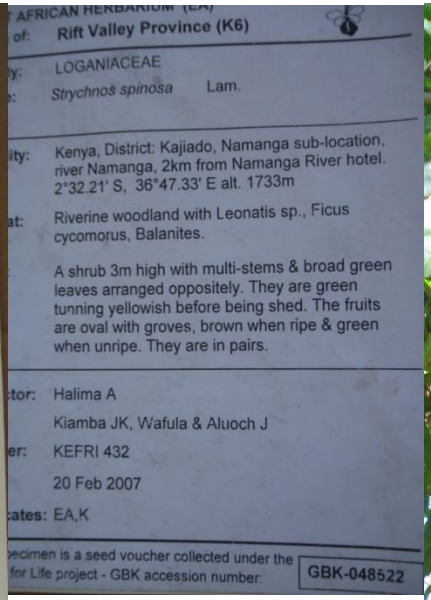
In flower

NMK botanic garden

Botanic garden collections

Strychnos spinosa Lam.

Herbarium voucher specimen



Voucher specimen label

Fruit

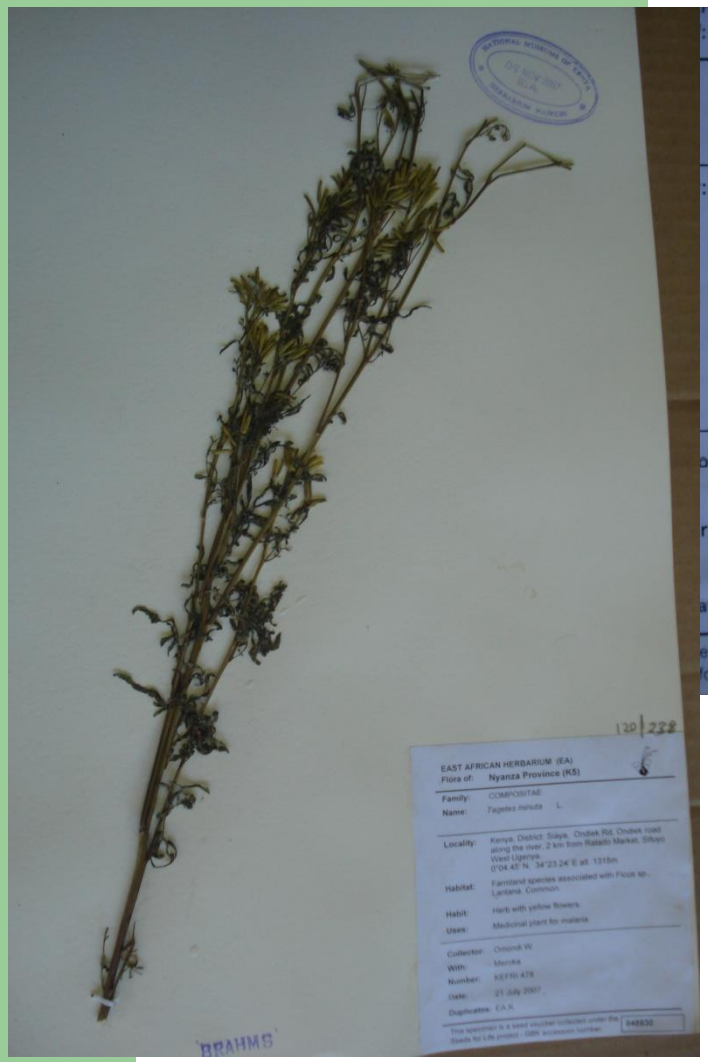
NMK botanic garden

Botanic garden collections

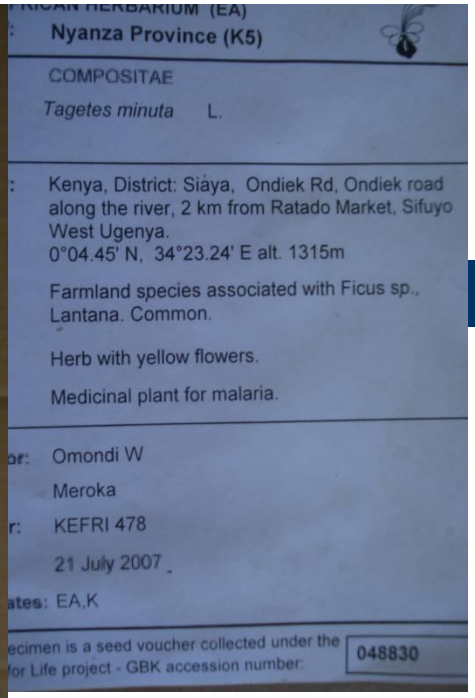
Tephrosia vogelii Hook.f. & Euphorbia tirucalli L.

NMK botanic garden and *on-farm* (Marimanti – Marimanti Girls Sec School Road

Tagetes minuta L.



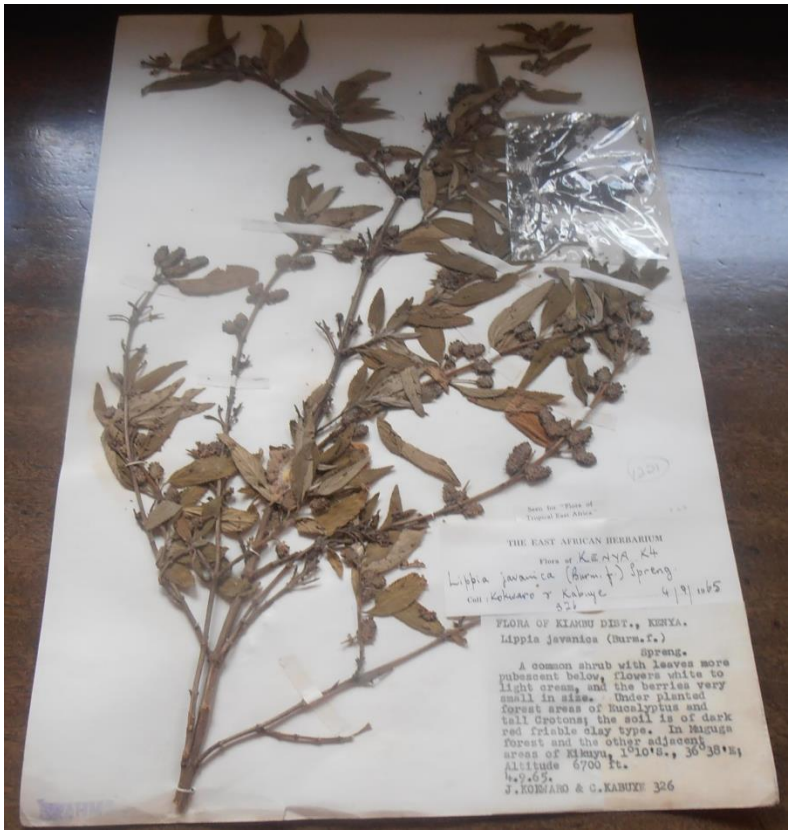
Herbarium voucher specimen



Voucher specimen label

NMK botanic garden

Lippia javanica (Burm.f.) Spreng.



NMK herbal garden

Summary of status – selected species

Species	Seed Bank GBK No.Access	National Parks	Forest Reserves	Botanic Garden	% Germination
Lippia javanica (Burm.f.) Spreng.	045057	Ol Donyo Sabuk, Masai Mara G.R.	Chyulu hills		80%
Aloe ferox Mill.				Cultivated in Nairobi museum gardens	
Zanthoxylum(Fagara) holtzianum (Engl.) P.G. Waterman			Arabuko Sokoke Forest, Gede Forest, Kaya Kinondo, Diani forest, Mrima hill, Shimoni, Mwasangombe Forest,		
Vernonia amygdalina Delile	048406	Kora National Reserve	Kakamega Forest, Mbololo forest, Chepalungu Forest		
Tithonia diversifolia (Hemsl.) A.Gray	048828	Meru N. Park	Mt. Kenya, Karura forest	Cultivated in Nairobi museum gardens	70%
Azadirachta indica A.Juss.			Gede forest, Jilore forest station	Gede Museum	
Zanha africana (Radlk.) Exell			Kiangombe Forest	Katumani Experimental Farm	
Neorauttanenia mitis(A.Rich.) Verdc.		Kora National Reserve, Meru N. Park, Tsavo West N.P.	Taita hills		

Status & Availability of germplasm

Species	Locality	Coordinates	Collection date	Gene Bank	Living collections
***Tagetes minuta* L.**	Makueni County	$01^0$42.019'S 037^0 23.750'E 1468m	20/02/2014	✓	
***Solanum campylacanthum* A.Rich.**	Tharaka Nithi, Makueni [2] & Laikipia West Counties	$00^0$07.081'S $037^0$59.090'E 659m, $01^0$42.019'S 037^0 23.750'E 1468m, $01^0$49.272' S 037^0 34.449' E 1227m & 00.29986^{0}N 036.312^{0}E 1985m	01/04/2013, 20/02, 15/07 & 07/08/2014	✓	
***Azadirachta indica* A.Juss.**	Kilifi, Kwale & Tharaka Nithi Counties	$03^0$38.109'S $039^0$59.370'E 14m, $04^0$23.177'S $039^0$37.172'E 69m & $00^0$07.081'S $037^0$59.090'E 659m.	31/05, 09/07 & 10/10/2014	✓	✓
***Securidaca longipedunculata* Fresen.**	Makueni [2] & Kwale Counties	01.81116^0 S 037.58559^0 E 1241m, $01^0$49.276'S $037^0$34.450'E 1294m & $04^0$23.177'S $039^0$37.172' E 69m.	16/06, 10 & 11/07 & 20/08/2014		✓
***Zanha africana* (Radlk.) Exell**	Makueni County (Cuttings)	$01^0$49.276'S $037^0$34.450'E 1294m	16/06/2014	–	–
***Tithonia diversifolia* (Hemsl.) A.Gray**	Meru County	$00^0$07.423'N $037^0$40.456'E 1470 m	27/06/2014	✓	
***Tephrosia vogelii* Hook.f.**	Kisii Central District & Meru County	$00^0$47.507'S $034^0$50.653'E 1766m & $00^0$07.466'N $037^0$40.422'E 1469m	07/06 & 26/06/2014	✓	✓
***Lippia javanica* (Burm.f.) Spreng.**	Laikipia West County	00.29986^{0}N 036.31285^{0}E 1985m	06/08/2014	✓	❖
***Euphorbia tirucalli* L.**	Tharaka Nithi County	$00^0$10.206'S 037^0 59.329' E 581m	11/10/2014	✓	❖

Challenges on germplasm management

- **Data bases not compatible and many not on line (ICRAF, GeRRI, NMK)**
- **Lack of taxonomic updates – *Solanum incanum, Carisa edulis, Millettia leucantha* are now synonyms**
- **Few Botanists / plant physiologists**
- **Inadequate appreciation of the potential value of GR at policy level**

THANK YOU