# Parasitic Plants in African Agriculture Biology and Control



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Old Dominion University

## The wisest man who ever lived studied plants!

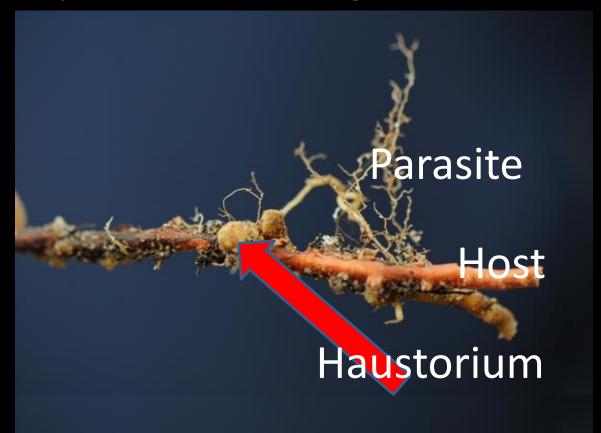
He [Solomon] spoke of plants, from the cedar of Lebanon to the hyssop. . . I Kings 4:33a

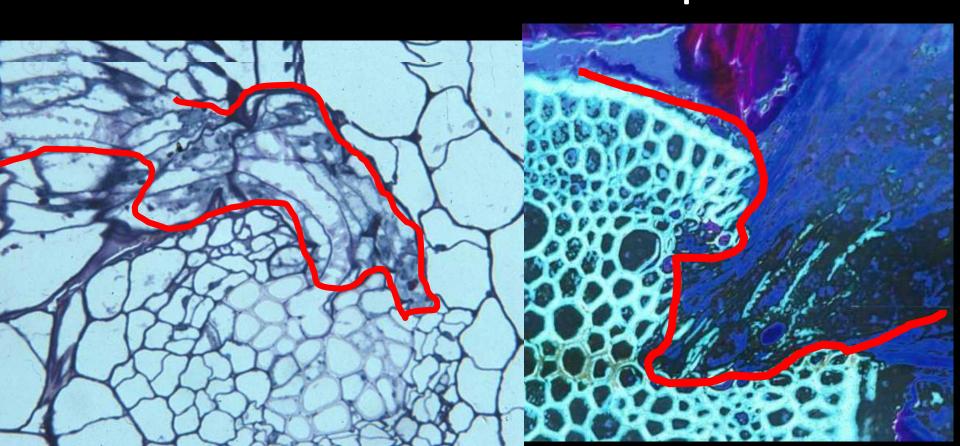


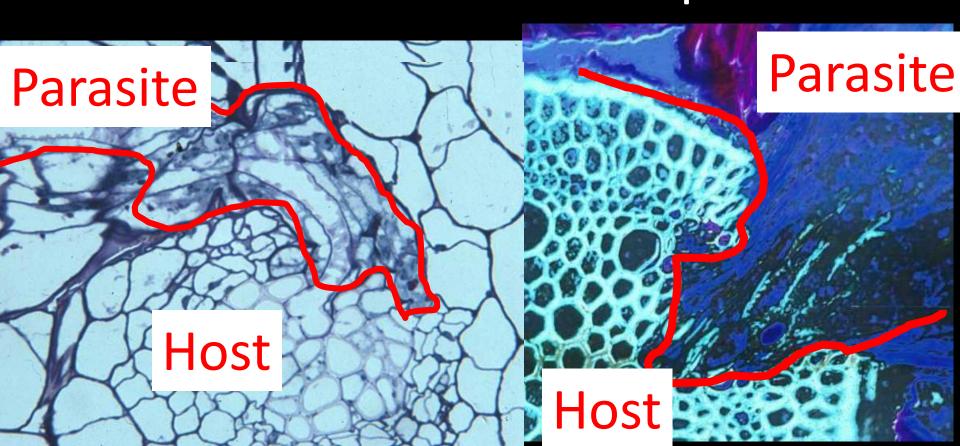
Countries with nascent infestation of Striga only 25 years ago are now showing heavy annual losses of crop yield. Rough estimates are nearly 300 million people in sub-Saharan Africa are adversely affected by Striga, and up to 50 million hectares of crop lands in the continent show varying degrees of Striga infestation. G. Ejeta in THE STRIGA SCOURGE IN AFRICA: A GROWING PANDEMIC. 2007

## Parasite Para + sitos=Eating at another's table

Parasitic plant=Having a haustorium







Host-parasite linkups are usually xylem to xylem

Movement can be either direction

Host-parasite linkups are usually xylem to xylem

Movement can be either direction NO HAUSTORIUM NO PARASITE

#### Economically important African parasites

Mistletoes, Species of Viscaceae, Loranthaceae et al.

Love-vine, Species of *Cassytha* Lauraceae

Dodders, Species of *Cuscuta* Convolvulaceae

Witchweeds, Species of Striga/Alectra Orobanchaceae

Facultative parasites, Rhamphicarpa, Orobanchaceae

Broomrapes, Species of *Orobanche* Orobanchaceae

#### Economically important African parasites

Mistletoes, Species of Viscaceae, Loranthaceae et al.

Love-vine, Species of Cassytha Lauraceae

Dodders, Species of *Cuscuta* Convolvulaceae



Broomrapes, Species of *Orobanche* Orobanchaceae







Numerous native species throughout Africa. Cuscuta campestris is the most common, introduced from United States. Native species are often confused with this, the most important agronomic species. Spread by contaminated seed

Hosts—alfalfa (*Medicago sativa*), diversity of dicot crops, weeds; onions

Obligate hemiparasites—cannot grow without host but do not need host to germinate. Some photosynthesis

Control—well-developed pre-emergent herbicides; seed cleaning

Cuscuta seeds have a rough surface

#### Economically important African parasites

Mistletoes, Species of Viscaceae, Loranthaceae et al.

Love-vine, Species of Cassytha Lauraceae

Dodders, Species of *Cuscuta* Convolvulaceae

Witchweeds, Species of Striga Orobanchaceae

Broomrapes, Species of Orobanche Orobanchaceae

Witchweeds, Species of Striga Orobanchaceae

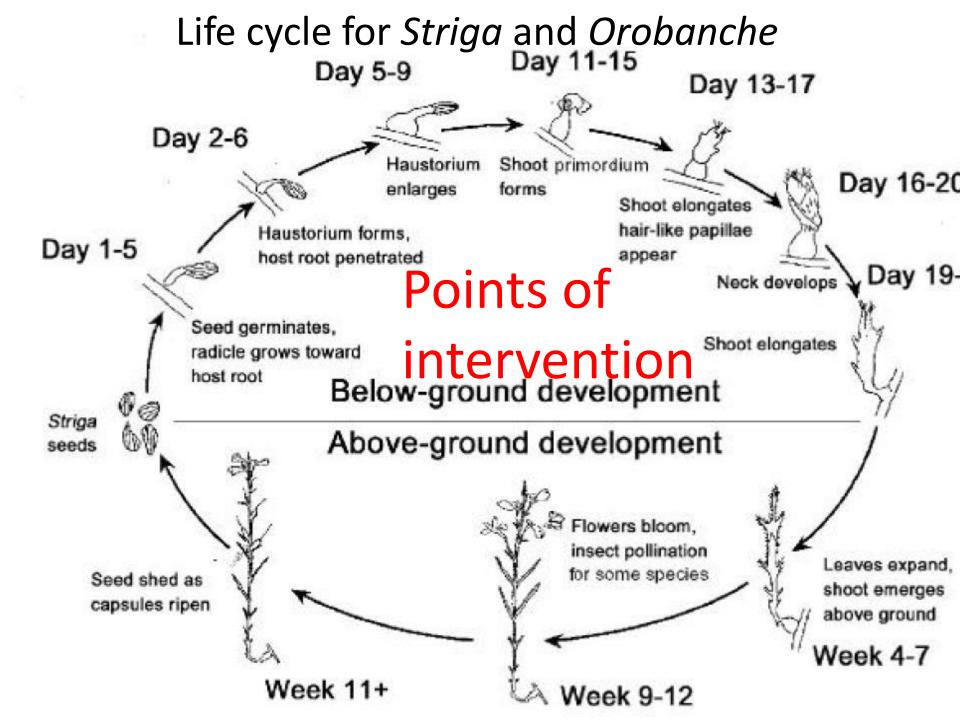
Alectra, Species of Alectra Orobanchaceae

Broomrapes, Species of Orobanche Orobanchaceae

Unique biology, not typical weeds

Seed biology—prodigious, need germination stimulants, can survive for 20 years in soil

Obligate parasites—damage done before plants are seen, parasitism vs competition



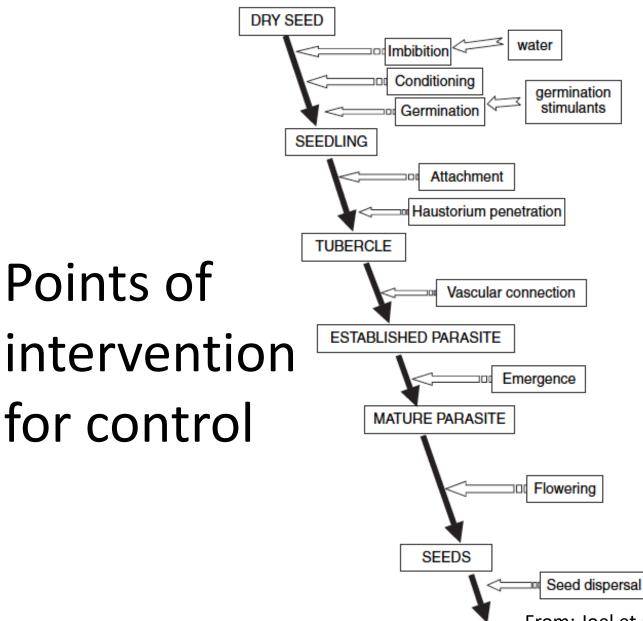


Fig. 4.1. Life cycle of a weedy root parasite.

Points of

From: Joel et al. Biology and management of weedy root parasites

### Economically important parasites Witchweeds Species of *Striga* Orobanchaceae

Striga hermonthica The big three

Striga asiatica

Striga gesnerioides

Striga aspera

Striga forbesii

#### Economically important parasites

Witchweeds Species of Striga Orobanchaceae

Striga hermonthica Most important, greatest damage

Striga asiatica

Striga gesnerioides

Striga aspera

Striga forbesii





Sorghum crop destroyed, Kadugli, Sudan







Striga hermonthica is an outcrosser, more variation within populations



This tiny seed is a vegetable computer capable of measuring water, temperature, host location, host type



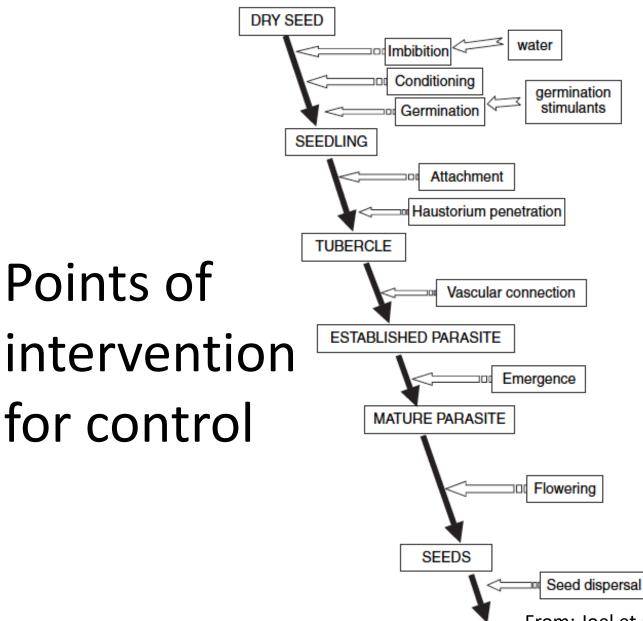
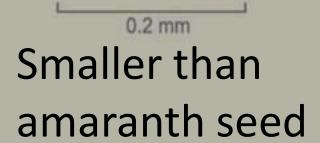


Fig. 4.1. Life cycle of a weedy root parasite.

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At this stage, damage to crop is already done and irreversible



Mainly Sahelian in distribution, south to Tanzania; likely introduced to Angola and Namibia



Hosts—all major grain crops including maize, sorghum, millet, finger millet, rice, tef. Insect pollinated, obligate outcrosser

Obligate parasites—dependent on host for germination, haustorial initiation. Some photosynthesis

Control—good control with herbicides, ethylene gas; anti-transpirants; most promising control is host tolerance; trap crops, push-pull

#### Economically important African parasites

Witchweeds Species of Striga Orobanchaceae

Striga hermonthica

Striga asiatica 🛑



Striga gesnerioides

Striga aspera

Striga forbesii





Striga asiatica is more temperate in its distribution so can survive in cooler climates. The introduction of this parasite to the states of North Carolina and South Carolina in the 1950's resulted in an intense research and control effort under a federal quarantine. Acreage of infestation has been drastically reduced







Mainly eastern and southern Africa in distribution; introduced to the United States. Harvested for medicine in Malaysia

Hosts—all major grain crops including maize, sorghum, millet, rice

Obligate parasites—dependent on host for germination, haustorial initiation. Some photosynthesis

Control—good control with herbicides, ethylene gas; anti-transpirants; most promising is host tolerance

#### Economically important African parasites

Witchweeds Species of Striga Orobanchaceae

Striga hermonthica

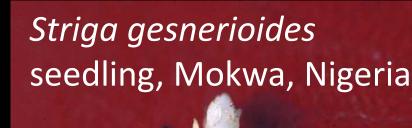
Striga asiatica

Striga gesnerioides



Striga aspera

Striga forbesii



Striga gesnerioides is an inbreeder, many host specific strains. Great variation between populations. Self-pollinating



Striga gesnerioides is the only witchweed to attack dicots. Diverse host families include:

Solanaceae Tobacco Nicotiana tabacum

Fabaceae Cowpea Vigna unguiculata and forage species of Alysicarpus and Tephrosia. Others?

Convolvulaceae species of *Ipomoea, Merremia, Jacquemontia* 

Euphorbiaceae species of Euphorbia

Acanthaceae species of Lepidagathis

Striga gesnerioides on Vigna unguiculata, cowpea; also attacks bambara, V. subterranea



## On cowpea in Benin (left) and Mali (right)



## Most widespread *Striga* in Africa, from the Mahgreb to Namibia



Hosts—attacks only dicots. Serious problem on cowpea (*Vigna unguiculata*) and bambara (*V. subterranea*)

Obligate parasites—dependent on host for germination, haustorial initiation.
Often chlorotic. Some photosynthesis

Control—good control with herbicides; most promising is host tolerance; blocking host signals

#### Economically important African parasites

Witchweeds Species of Striga Orobanchaceae

Striga hermonthica

Striga asiatica

Striga gesnerioides

Striga aspera

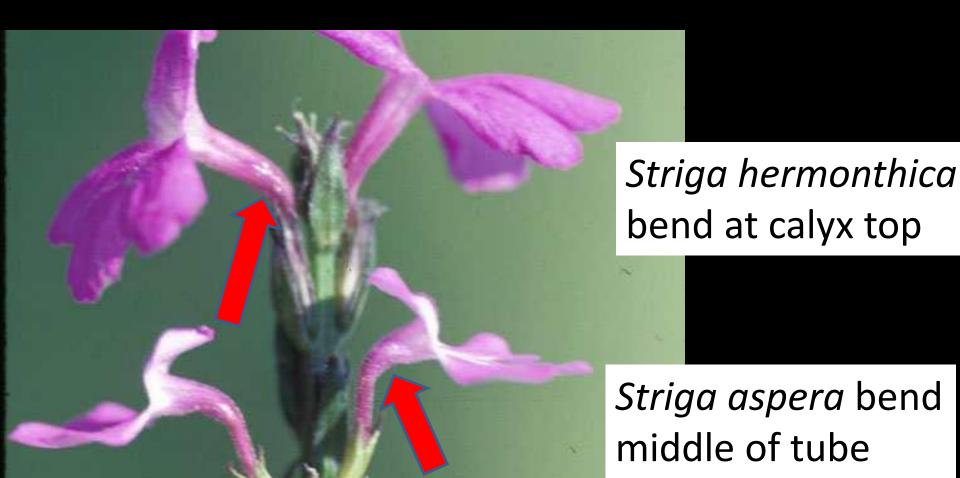




Striga aspera is often confused with S. hermonthica. A good field character is the location of the bend in the floral tube



Striga aspera is found in native grasslands, unlike S. hermonthica which is a true agrestral weed (only in cultivated fields)







Restricted to the Sahelian, Savanna region of Africa



Hosts—sorghum, sugar cane, fonio (*Digitaria exilis*), millet, rice

Obligate parasites—dependent on host for germination, haustorial initiation. Some photosynthesis

Control—likely the same as for *S. hermonthica* 



#### Economically important African parasites

Witchweeds Species of Striga Orobanchaceae

Striga hermonthica

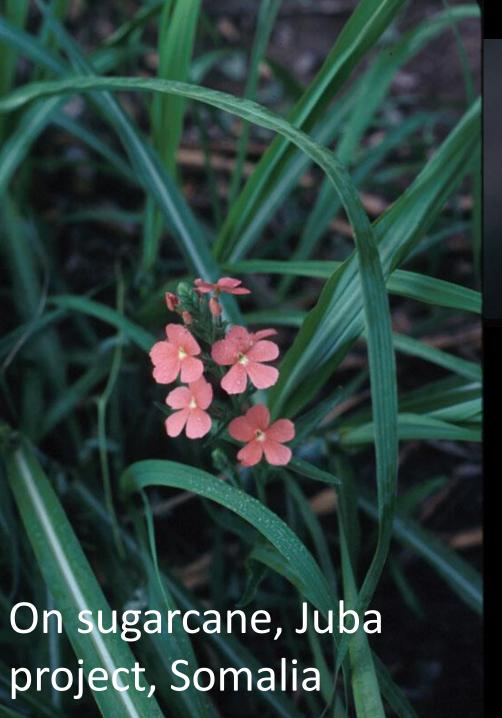
Striga asiatica

Striga gesnerioides

Striga aspera

Striga forbesii







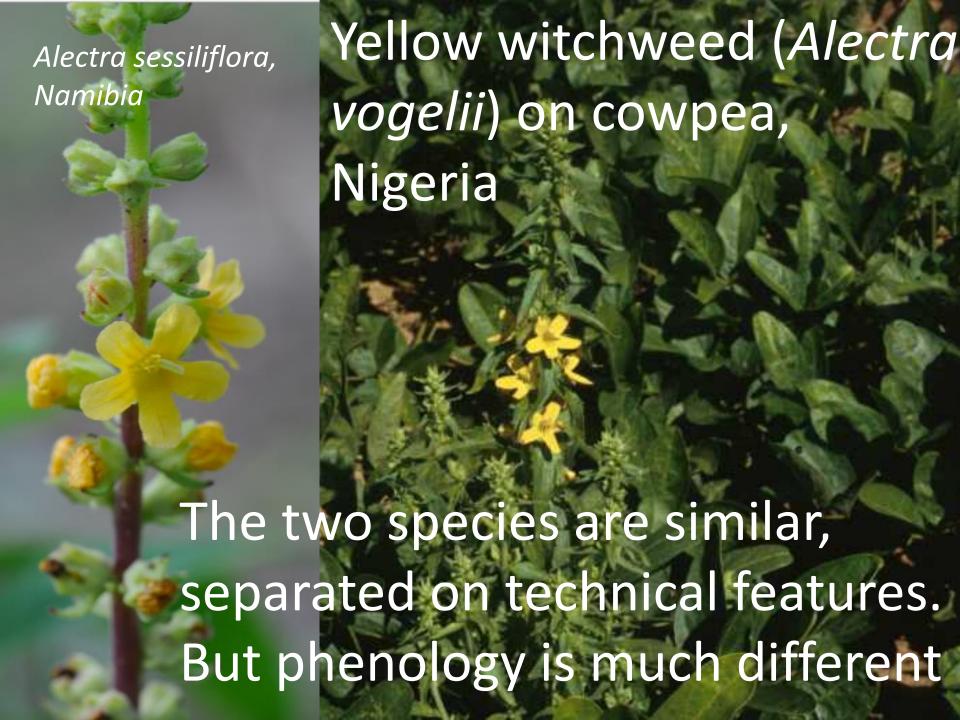
Striga forbesii



Hosts—serious damage to sugar cane in Somalia, maize and sorghum in Zimbabwe

Obligate parasites—dependent on host for germination, haustorial initiation. Some photosynthesis

Control—little information but perhaps similar to *S. hermonthica* and *S. asiatica* 



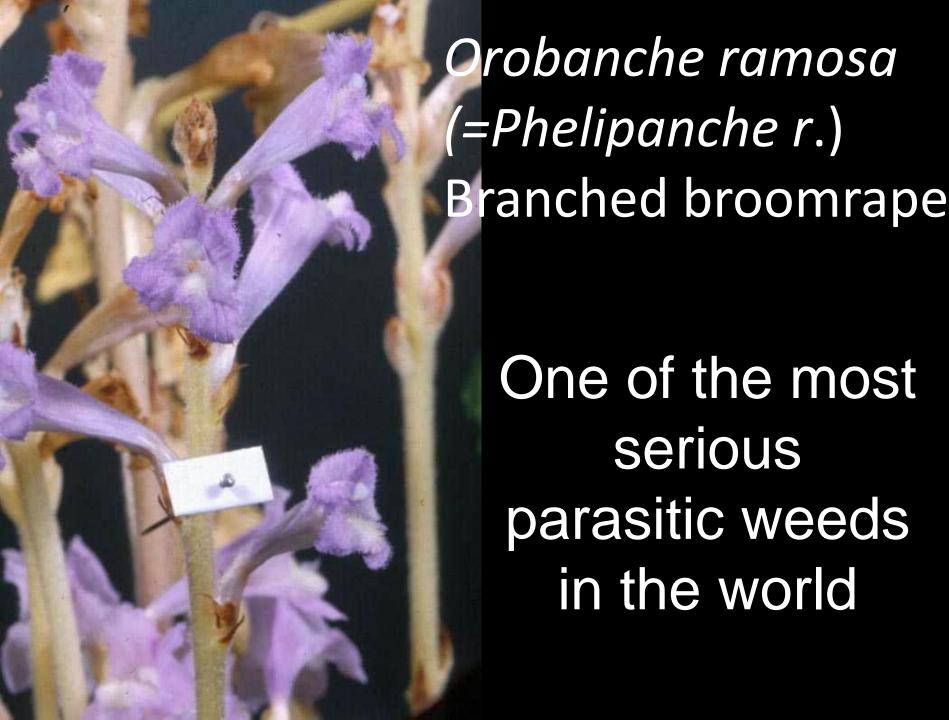
Hosts—attacks dicots, serious problem on cowpea (Vigna unguiculata) bambara nut (V. subterranea), peanut (Arachis hypogea), sunflower (Helianthus annuus)

Obligate parasites—dependent on host for germination, haustorial initiation. Some photosynthesis

Control—limited information, some herbicides including imazaquin and others which have shown efficacy in control of yellow witchweed







#### Hosts include:

**Tomato** 

Tobacco

Hemp

Eggplant

Potato

Cauliflower

Cabbage

Lettuce

Melon

Various legumes

Ornamental species

Numerous native species

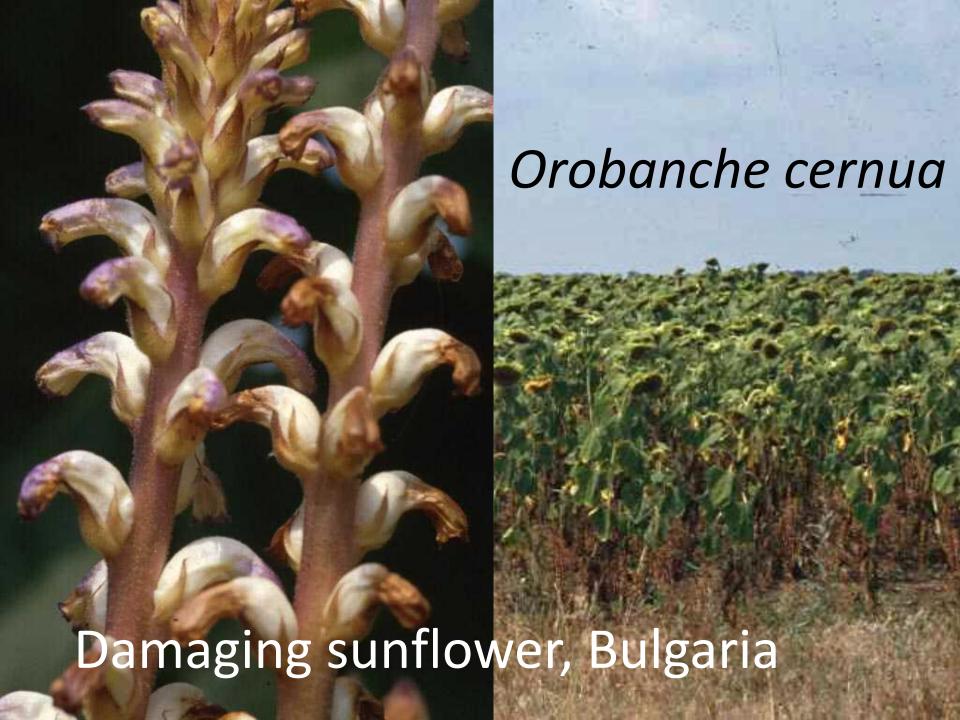




Orobanche crenata a big problem on broad beans in Egypt and Ethiopia







### Control of Witchweeds and Broomrapes

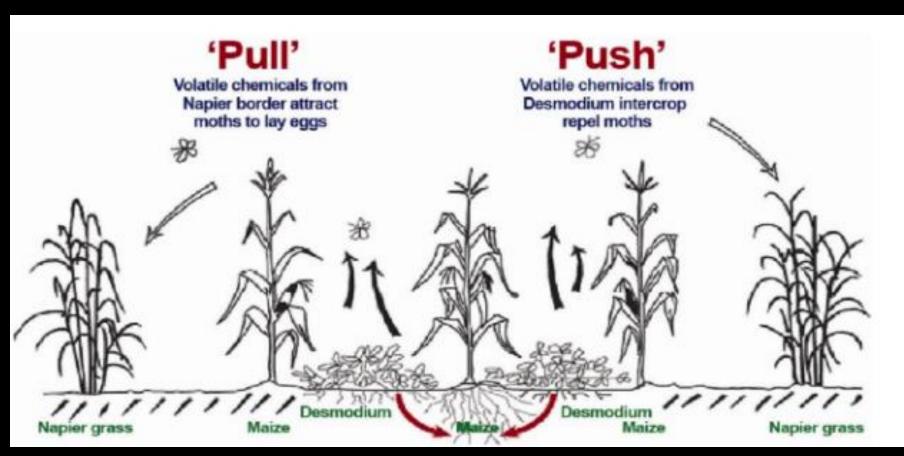
Chemical
Herbicides
Chemical communication

Biological/Ecological
Trap crops: Push-pull,
shifting cultivation



Rig for ethylene injection, US

Breeding for "Resistance"



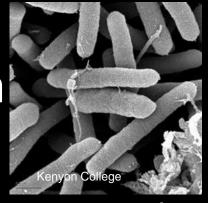
Desmodium causes "suicidal" Striga germination

Control (contd.)
Biocontrol (*Striga*)

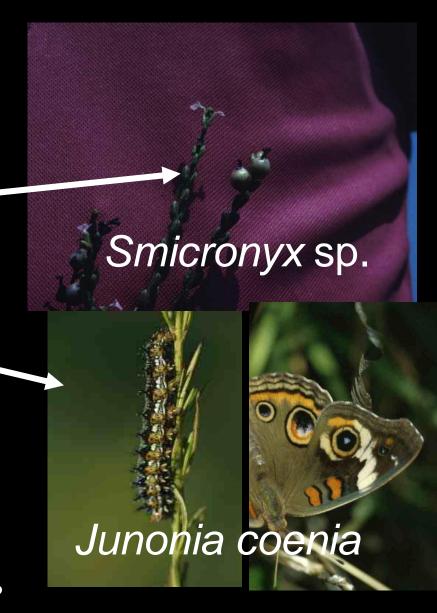
Weevils

Lepidopterans.

Bacteria



Pseudomonas syringae releases ethylene in soil





# A new form of witchweed control?

#### Cannabis sativa Marijuana





Home \ Today's pick \ Kamuli COA asks Parliament to ban the smoking of Striga

#### Kamuli COA asks Parliament to ban the smoking of Striga

By Paul Kiwuuwa Added 31st May 2018 12:29 PM

According to Aduma, over 60% of crimes committed in the region is done by youth who smoke Striga



#### Sanitation



Witchweed is commonly spread in contaminated crop seed. Burn plants after weeding

Do not use witchweeds for fodder. Seeds can still germinate after passing through cattle

# HAUSTORIUM

Parasitic Plants Newsletter

ISSN 1944-6969

Official Organ of the International Parasitic Plant Society

(http://www.parasiticplants.org/)

Imusselm@odu.edu

December 2017 Number 72





## Thanks!!

شکرا



Terima Kasih



### Acknowledgements to so many!

#### Students

Kamal Mohamed

Hani Abu-Sbeih

**Emmanuel Aigbokan** 

Yarama Ndirpaya

**Daniel Nickrent** 

David Knepper

#### **Scientists**

Faiz Bebawi

Johann Visser

**Bob Eplee** 

Magzoub Bashir

Nigel Hepper



**Chris Parker** 

Erika Maass

Dana Berner











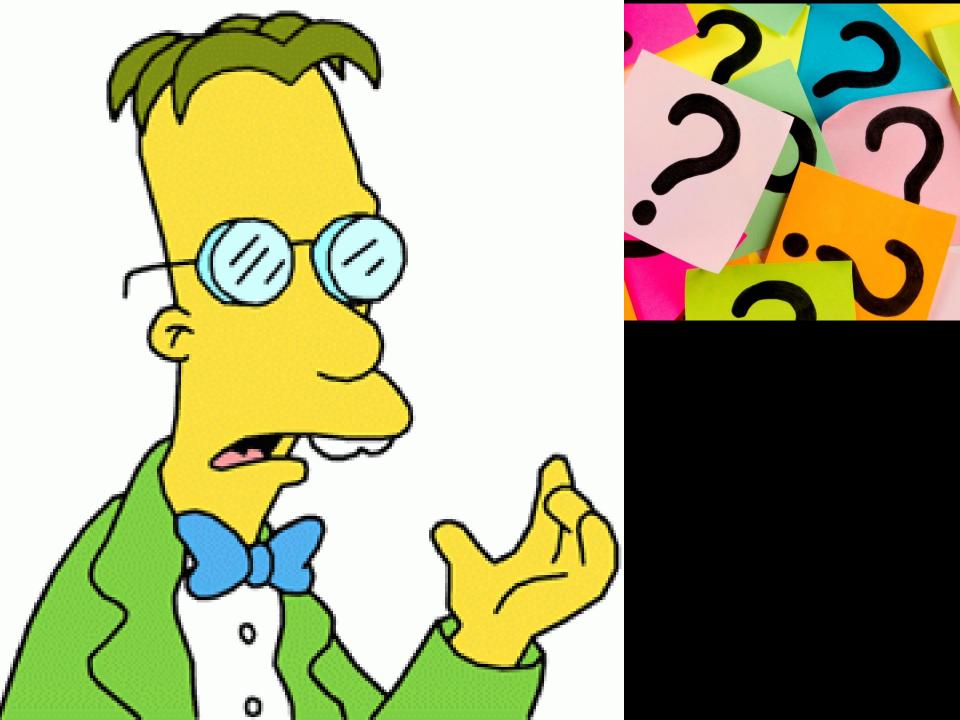




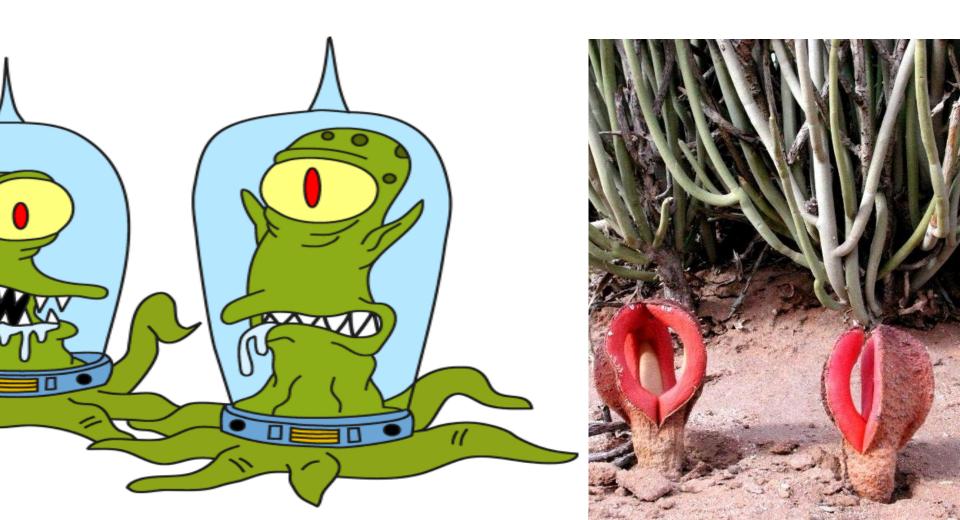








#### Like something from another planet



## Economically important parasites

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Broomrapes, Species of Orobanche Orobanchaceae

#### Orobanche ramosa USA

#### Nutrition dependence

Hemiparasite Holoparasite Viscum cruciatum on almond, Palestine

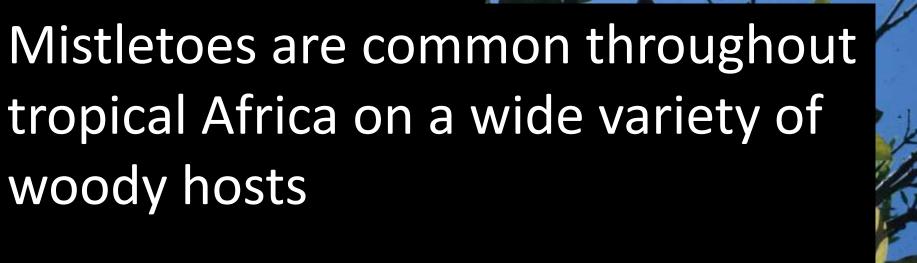
Germination dependence

Obligate holoparasite

Facultative parasite
Obligate parasite

Obligate hemiparasite







Hosts—rubber, guava, cola nut, apple, broad host range. Role of birds

Obligate hemiparasites—cannot grow without host but do not need host to germinate

Germinating seed

Control—difficult, physical removal of parasite

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Hosts—broad host range, woody and herbaceous. Little economic importance

Obligate hemiparasites—cannot grow without host but do not need

host to germinate

Control—little studied, removal?



Often confused with dodder (*Cuscuta*), especially in vegetative state. *Cassytha* stem is covered with short hairs, all *Cuscuta* stems lack hairs. Flowers are much different





Rice growing regions of West Africa, East Africa, and Madagascar. A **facultative** hemiparasite

