

Non Pesticidal Management



ဒေါ်မြင့်မြင့်ထွန်း
ဒုတိယဦးစီးမှူး
မြေအသုံးချရေးဌာနခွဲ

Contents

Non Pesticidal Management

1

Growing Healthy Plant

2

Reducing Pest Number

3

**Understanding Pests Biology
& Behavior**

4

1. Non Pesticidal Management

Non Pesticidal Management

“**Ecological approach** to pest management using **knowledge and skill** based practices to prevent insects from reaching damaging stages and damaging proportions by making **best use of local resources, natural processes and community action.**”

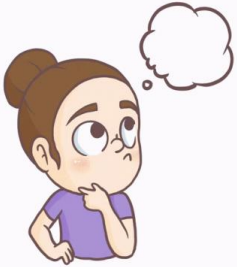
Based on

- Understanding **crop ecosystem and suitably** modifying it by adopting suitable cropping systems and crop production practices.
- Understanding **insect biology and behavior and adopting suitable preventive measures** to reduce the pest numbers.
- Building **farmers knowledge and skills** in making the best use of local resources and natural processes and community action.

History of Non Pesticidal Management

*****K. Venu Madhav.*****

1st Pesticide Free Village in India, 2005



A. ROY CHOWDHURY



A farmer spraying pesticides in Mehboobnagar district of Andhra Pradesh.



Punukula village (Andhra Pradesh, India).

The core of the NPM strategy is use of the neem tree.

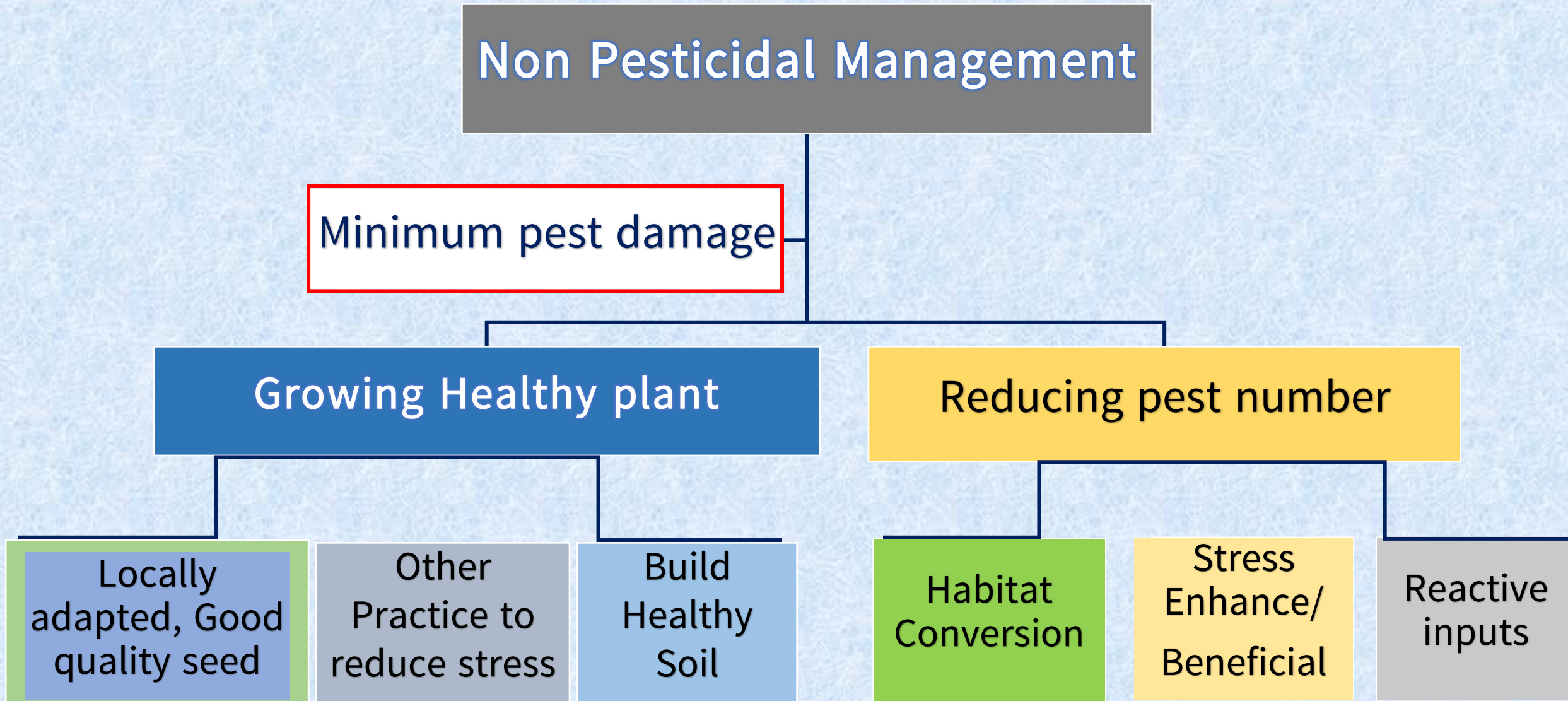


Myint Myint Tun _ Non Pesticidal Management



Ingredients for making chili-garlic solution.

Schematical representation of non pesticidal management



Pests?

“When we speak of **crop pests**, we mean **all organisms** that threaten the quality and yield of crops (higher animals, lower animals, micro organisms, higher plants)” (S. Piet and H. Rik et. Al., 2007).

Characteristics of the pests

- ❑ သီးနှံစိုက်ခင်းထဲမှာရှိတဲ့ အပင်တစ်ပင်ခြင်းဆီကို ဖျက်ဆီးခြင်း
- ❑ လျင်မြန်စွာ ပွားများပေါက်ပွားနိုင်ခြင်း
- ❑ သီးနှံပင်များကို ထိခိုက်ပျက်စီးစေခြင်း



INSECT PREDATORS & PARASITOIDS:- INTRODUCTION & IDENTIFICATION

An insect predator is natural enemies of pests that attacks, feeds on, and kills more than one prey during its life time. They are generally larger and stronger than their prey. They are often generalists rather than specialists on any one prey type and eat both adults and immature stages.



Ladybird Beetle



Soldier beetle



Ground beetle



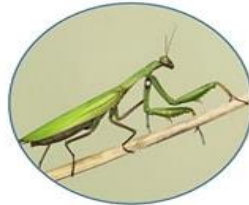
Ground beetle



Rove beetle



Tiger beetle



Praying Mantids



Green lacewings



Hoverfly/syrphid fly



Robber fly



Dragon fly



Damsel Fly



Snake fly



Assassin bug



Bigeyed Bugs



Long legged fly

An insect Parasitoids:- are natural enemies of pests and kill by devouring their prey from the inside out. Parasitoids develop within their pest host, and are parasitic only in their immature stages killing their host just prior to maturity. Parasitoids play a vital role in the garden because they provide significant control of a number of pests, including aphids, scale insects, leafhoppers, mealybugs, and caterpillars.



Trichogramma sp.



Aphidius sp



Aphelinus sp.



Parasitic wasp



Braconid Wasp



Ichneumon Wasp



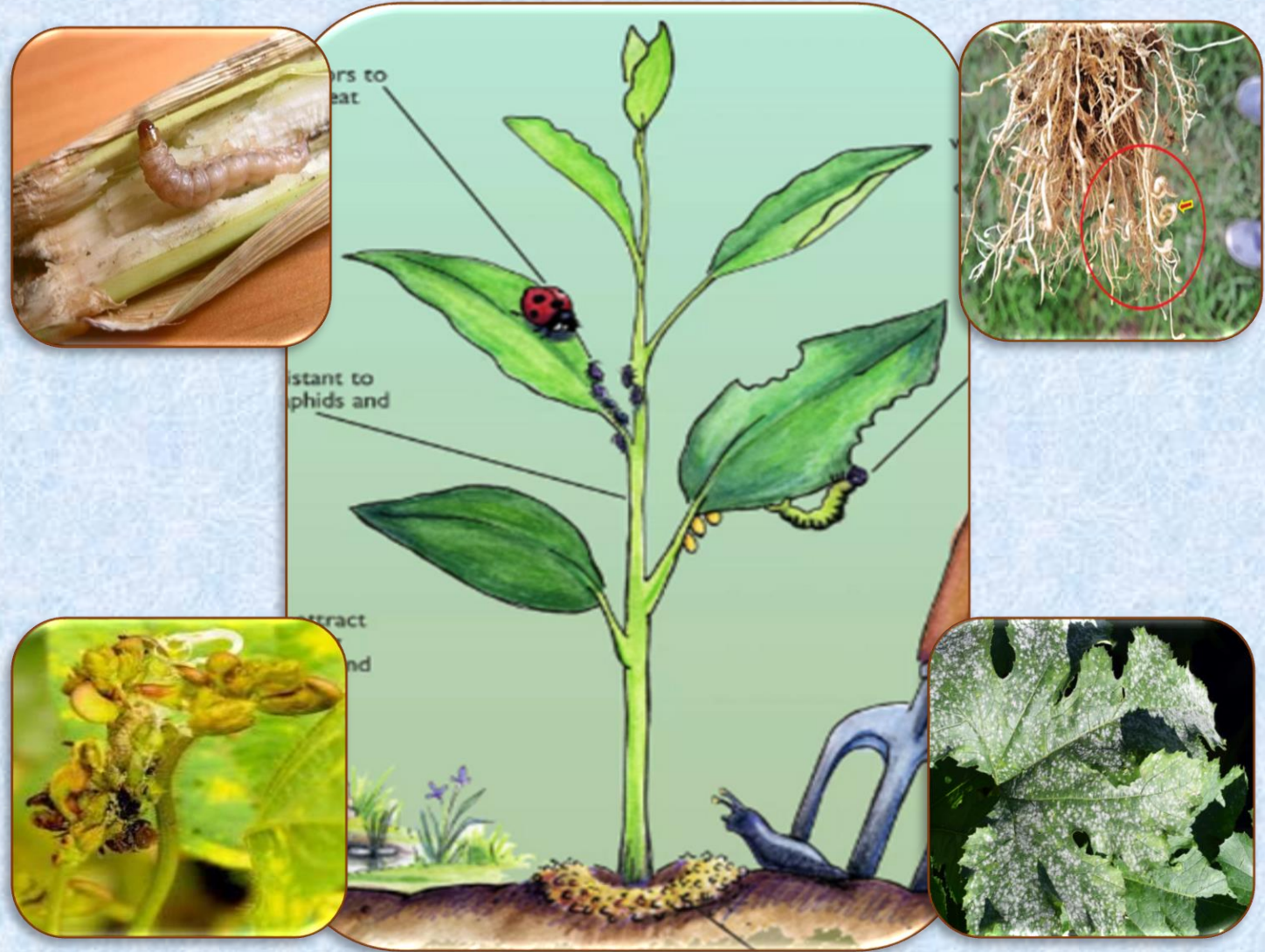
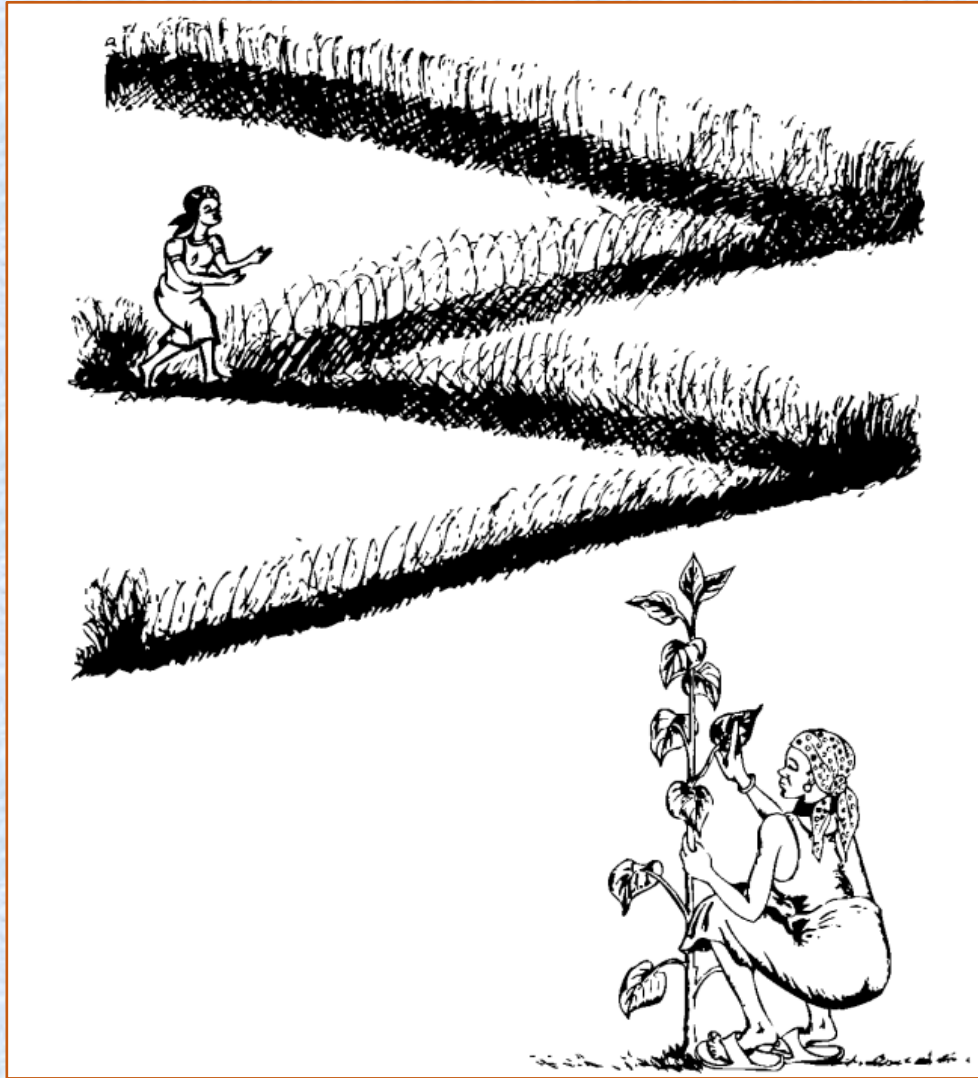
Tachinid Fly



Encyrtid Wasps

S.N	Natural Enemy	Prey or Pest Targeted
1	Praying mantid	Flies, wasps, bees, caterpillars, moths, and butterflies.
2	Predatory beetles (ground beetles, lady beetles, rove beetles, soldier beetles, etc.)	Mites, aphids, leafhoppers, mealybugs, thrips, insect eggs and small larvae, scale insects, and whiteflies.
3	Lacewings and snake flies	Mites, aphids, leafhoppers, whitflies, thrips, mealybugs, caterpillars, insect eggs, and scale insect
4	Predatory flies (hover flies, robber flies, bee flies, dance flies, longlegged flies etc.)	Mites, aphids, scale insects, thrips, caterpillars, beetle larvae, flies, wasps, grasshoppers, and bees.
5	Parasitic wasps (chalcids, encyrtids, braconids, ichneumonids, etc.)	Aphids, mealybugs, caterpillars, true bugs, beetles, leafhoppers, spiders, whiteflies, and insect eggs.
6	Trichogramma sp.	control cabbageworm, , corn Earworm, codling Moth, cutworm, armyworm, webworm, cabbage Looper, corn Borer, fruitworms, diamondback moth, tent caterpillar

What is the first step to any pest management plan?



2. Growing Healthy plant

1. Good Quality Seed

- Variety purity
- Satisfactory germination and vigor
- Freedom from other materials (plant debris, dead or broken seeds, seeds of other crops, weed seeds, noxious and parasitic weed seeds also non-plant materials).
- Freedom from seed-borne pest and disease.



2. Reduce Stress

ရေငတ်ခြင်း၊ အေးလွန်းခြင်း၊ ပူလွန်းခြင်း၊ ဆားပေါက်ခြင်း...

သက်ရှိအပင်များဖြင့် မြေဖုံးခြင်း



အပင်အကြွင်းအကျန်များဖြင့် မြေဖုံးခြင်း



Mycorrhiza ထည့်သွင်းခြင်း



Trichoderma ထည့်သွင်းခြင်း



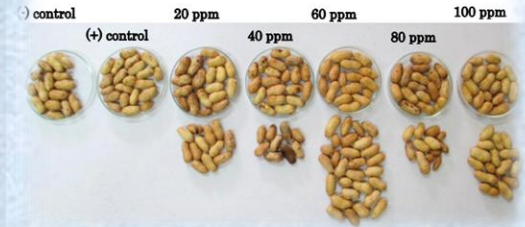
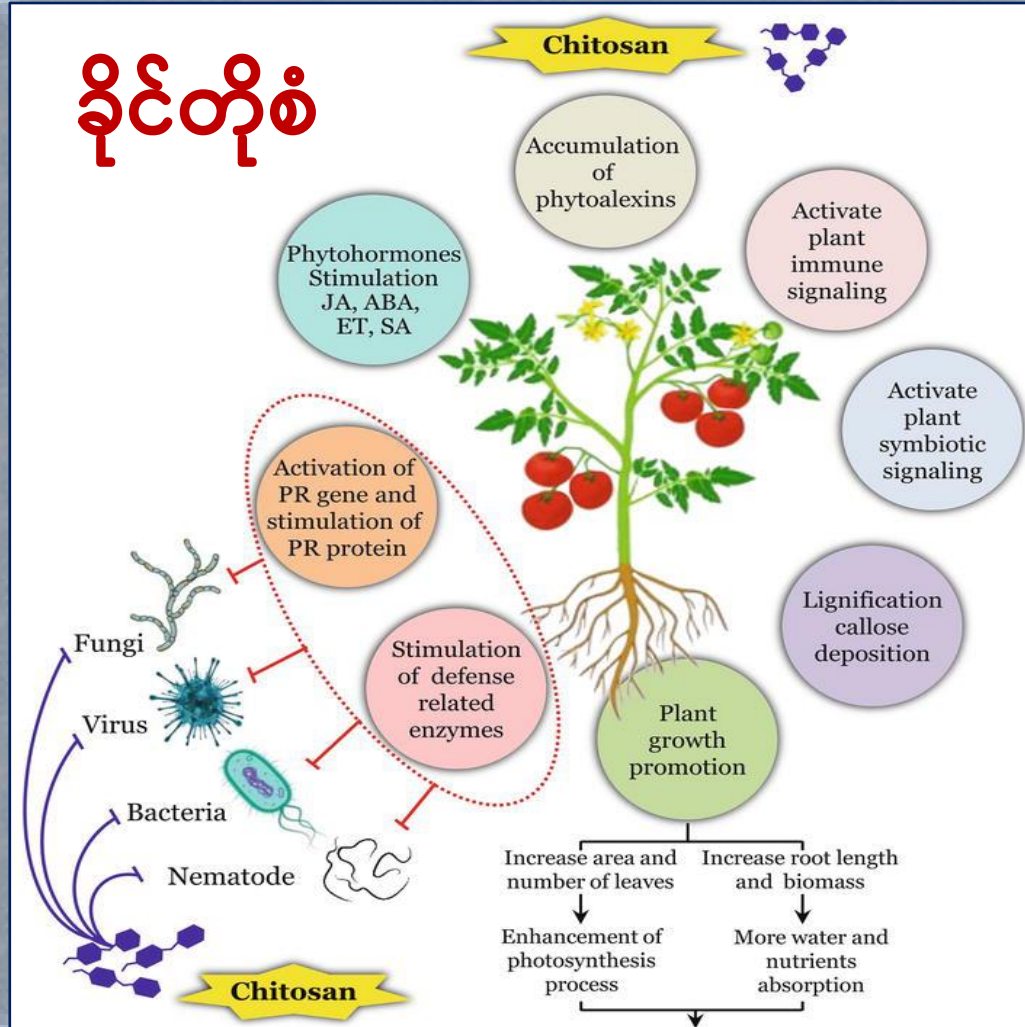
Source: DAR

Chitosan အသုံးပြုခြင်း



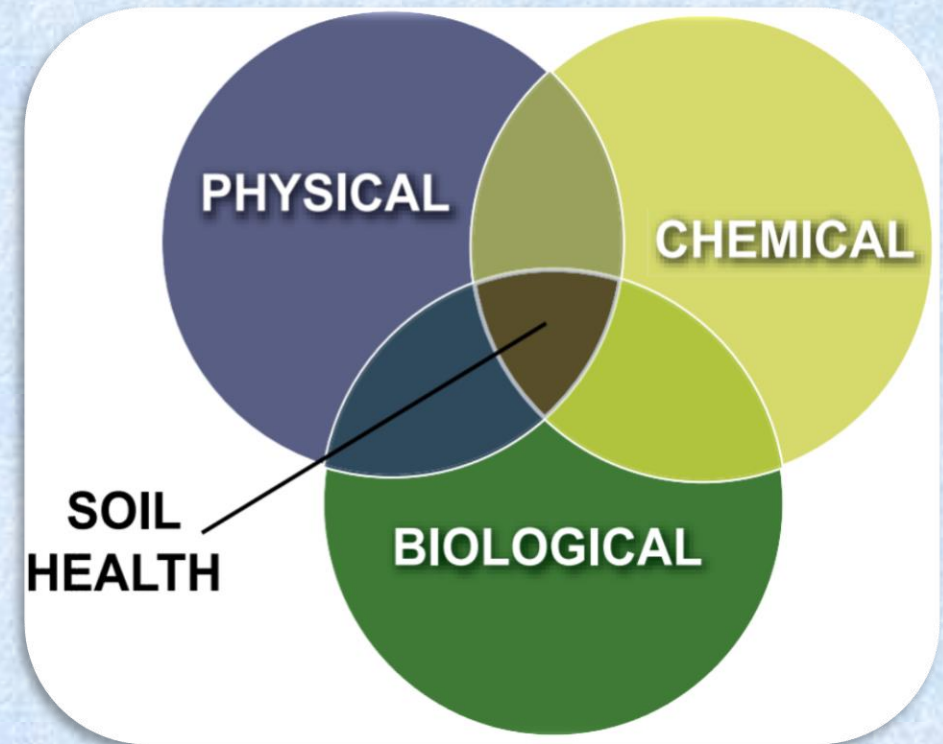
Chitosan used in Agriculture

- ❑ Plant Growth Promoter
- ❑ Enhanced crop yield
- ❑ Disease Suppression
- ❑ Biopesticides
- ❑ Bio fungicides
- ❑ Soil Amendments
- ❑ Post Harvest Preservation
- ❑ Biodegradable mulch



3. Build Healthy Soils

- Healthy soil is that which allows plants to grow to their maximum productivity without disease or pests and without a need for off-farm supplements.
- Healthy soil is teeming with bacteria, fungi, algae, protozoa, nematodes, and other tiny creatures. Those organisms play an important role in plant health.
- Healthy soil is a living soil and it gives healthy crop.



Characteristics of a Healthy Soils

1. Good Soil Tilth



The effect of organic matter on the same soil type managed using conventional plow tillage (left) or zone tillage for 10 years (right)(Cornell Soil Health Manual, 2009)

Characteristics of a Healthy Soils

2. Sufficient Depth
3. Sufficient but not excess supply of nutrients
4. Small populations of plant pathogens and insects pests
5. Good soil drainage
6. Large population of beneficial organisms
7. Low weed pressure
8. Free of chemical and toxins that may harm to the crops
9. Resistant to land degradation
10. Resilience when unfavorable condition occur

Common Soil Constraints

1. Soil compaction



Ruts resulting from late fall harvest when soils are wet

2. Soil crust



Surface crusting in mid-spring.

3. Weed Pressure



Weedy beet field.

Common Soil Constraints

4. High population of Soil borne pathogens and diseases



Symptoms of root rot diseases on pea roots.

5. Low water use and Nutrients Retention



Application of liquid manure.

Thirty-nine potential indicators evaluated for use in the soil health assessment protocol

Physical

1. Bulk density
2. Macro-porosity
3. Meso-porosity
4. Micro-porosity
5. Available water capacity
6. Residual porosity
7. Penetration resistance at 10 kPa
8. Saturated hydraulic conductivity
9. Dry aggregate size (<0.25 mm)
10. Dry aggregate size (0.25 - 2 mm)
11. Dry aggregate size (2 - 8 mm)
12. Wet aggregate stability (0.25 -2 mm)
13. Wet aggregate stability (2 - 8 mm)
14. Surface hardness with penetrometer
15. Subsurface hardness with penetrometer
16. Field infiltrability



Biological

17. Root health assessment
18. Beneficial nematode population
19. Parasitic nematode population
20. Potential mineralizable nitrogen
21. Decomposition rate
22. Particulate organic matter
23. Active carbon
24. Weed seed bank
25. Microbial respiration rate
26. Glomalin
27. Organic matter content

Chemical

28. Phosphorus
29. Nitrate nitrogen
30. Potassium
31. pH
32. Magnesium
33. Calcium
34. Iron
35. Aluminum
36. Manganese
37. Zinc
38. Copper
39. Exchangeable acidity

How to Build a Healthy Soils in your farm?



“Production practices, such as putting on **crop residues** or other biomass as surface **mulch**, using **compost** and **green manures**, **intercropping of legumes** in cropping systems, and **biocontrol** of insect pests and diseases, all help to enhance yields and sustain soil fertility and health (Rupela et al., 2007).”

မြေဆီလွှာကောင်းမွန်လာစေရန် အရိုးရှင်းဆုံးနည်းလမ်း?

မြေဆွေး (Compost)

Vs

မြေဖုံး (Mulch)



မြေဖုံးပင်ရွေးချယ်ခြင်း

မြေဖုံးပင်စိုက်ခြင်း၏

ရည်ရွယ်ချက်

- ✓ မိုး- ဖုံးကာပင်
- ✓ ခြောက်သွေ့-ပင်ကြွင်းဖုံးပေး

- ✓ လူအစားအစာရနိုင်လား
- ✓ ကျွဲနွားအစားအစာရနိုင်လား
- ✓ ထင်း/သစ်
- ✓ မြေဆီဩဇာတိုးတက်စေနိုင်လား
- ✓ ပေါင်းကာကွယ်နိုင်မှု
- ✓ ဆေးဝါးအဖြစ်အသုံးပြုနိုင်လား

ပဲကြီး
ပဲယင်း
စားတော်ပဲ



ဘောစကိုင်း
လက်ဖက်
ညံပင်
ပိုက်ဆံလျှော်



သစ်စိမ်းမြေဩဇာထည့်သွင်းခြင်း

ပဲမျိုးရင်းဝင်အပင်များအား သစ်စိမ်းမြေဩဇာအဖြစ် ရည်ရွယ်၍ စိုက်ပျိုးပြီး လုံလောက်သည့် အပင်ကြီးထွားမှု ရရှိချိန်၊ နိုက်ထရိုဂျင်ဓါတ်ရရှိစေရန် မဆွေးမြေ့သည့် အစိမ်းရောင် အစိတ်အပိုင်းများကို မြေဆီလွှာသို့ ထည့်သွင်းခြင်းဖြစ်သည်။



3. Reducing Pest Number

1. Habitat Conversion and Enhancement

(1) Crop Diversity (သီးနှံမျိုးစုံကို ရောစပ်စိုက်ပျိုးခြင်း)

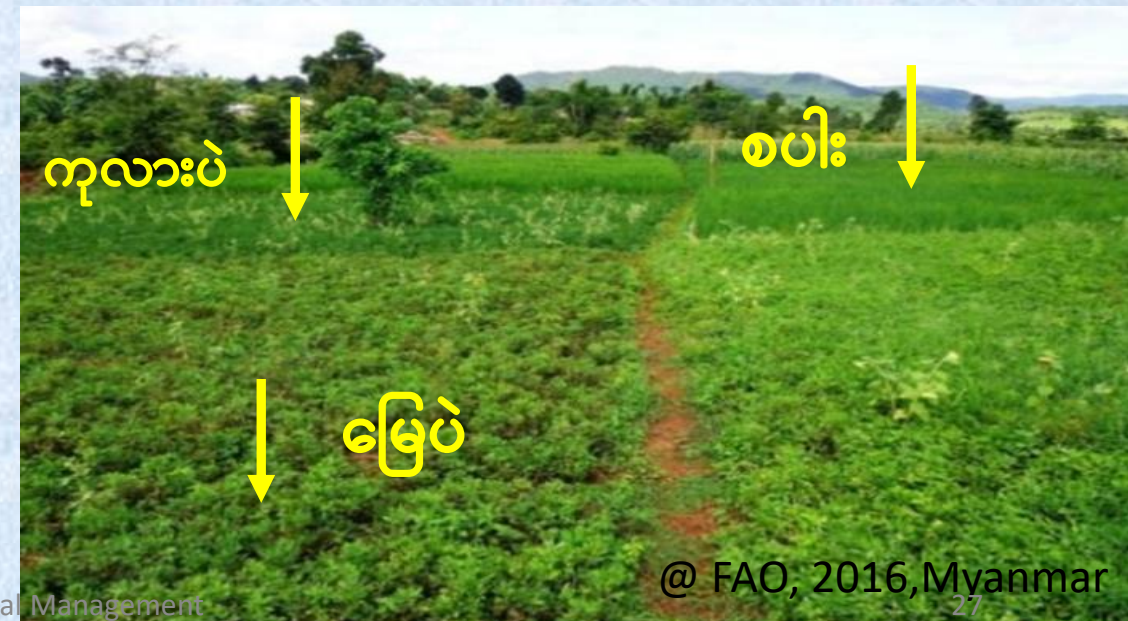
- ✓ အပင်ပုံစံ၊ အမြစ်ဖွဲ့စည်းပုံနှင့် အာဟာရစုပ်ယူပုံမတူညီသည့် သီးနှံပင်များအား ရွေးချယ်ရန်
- ✓ အနည်းဆုံး သီးနှံမျိုးစေ့ (၂)မျိုး/ (၃) မျိုး ကို ရောစပ် (သို့) အလှည့်ကြစိုက်ပျိုးရန်



နှံစားသီးနှံများ + မြက်မျိုးများ
အဓိကရွယ်ချက်-မြေပြင်ကို အစဉ်ဖုံးအုပ်ကာကွယ်ခြင်းဖြစ်
နွေရာသီ- အပင်ကြွင်းဆက်လက်ဖုံးအုပ်ထားရန်လို

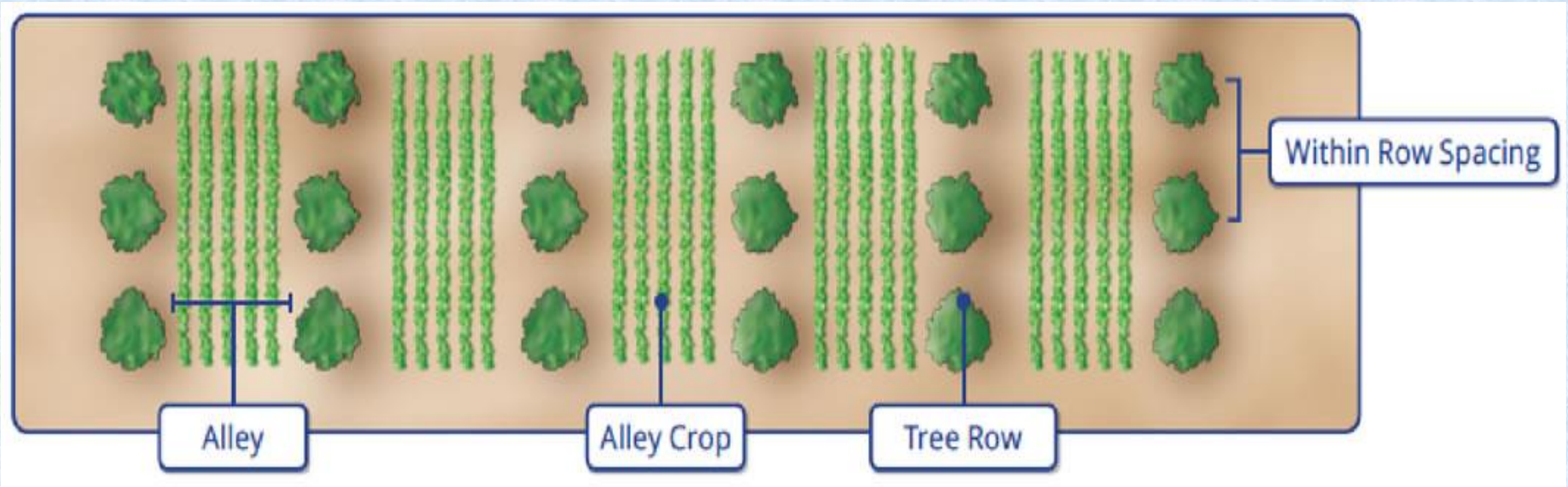
သီးနှံမျိုးစုံကို အလှည့်ကျစိုက်ပျိုးခြင်း

- သီးလှည့်စိုက်ပျိုးခြင်းသည် စိုက်ပျိုးရာသီအစီအစဉ်အလိုက် ဧရိယာတစ်ခုတည်းတွင် သီးနှံအမျိုးအစား မတူညီသော သီးနှံများကို အလှည့်ကျဆက်တိုက် စိုက်ပျိုးခြင်းဖြစ်ပါသည်။
- သီးနှံတို့၏ ရေလိုအပ်ချက်မှာ အနည်းအများ ကွာခြားသဖြင့် ရေချွေတာနိုင်သည့် နည်းလမ်းတစ်ခုဖြစ်။
- အလွှာစုံမှ အဟာရများ ရရှိအောင် လုပ်ဆောင်ပေး။
- မြေအစိုဓာတ်ကို ထိန်းထားပေးနိုင်သည့် နည်းလမ်းကောင်း တစ်ခုဖြစ်။



Other Agronomic Practices

“**Alley cropping** is defined as the planting of rows of trees and/or shrubs to create alleys within which agricultural or horticultural crops are produced” (U.S DOA).



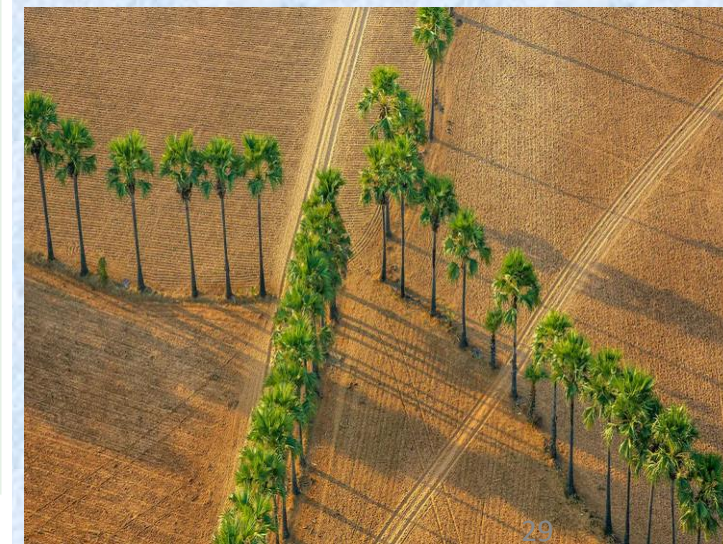
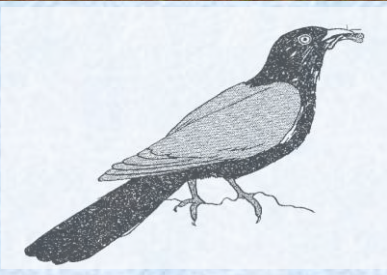
Common terminology used when discussing alley cropping systems are alley, alley crop, tree row, and within row spacing. (USDA National Agroforestry Center Illustration)

Alley Cropping

Benefits

Alley cropping is supported by many conservation programs. Compared with monoculture systems, alley cropping can provide:

- Increased economic diversity, land use efficiency, and overall farm yield.
- Ability to transition to a new enterprise gradually rather than all at once.
- Reduced wind and water erosion.
- Improved pollinator and wildlife habitat.
- Potential for reduced incidence of pests and disease.
- Increased air and soil moisture.
- Increased carbon sequestration.
- Reduced nutrient leaching to groundwater.



4. Understanding Pests Biology & Behavior

Weeds

“A weed is a plant out of place”

What do weeds do?

- ❑ သီးနှံပင်တွေနဲ့ အာဟာရ၊ အလင်းရောင်၊ ရေ၊ နေရာ ယှဉ်ပြိုင်လှ
- ❑ သီးနှံအရည်အသွေးနှင့် အထွက်ကျဆင်းစေ
- ❑ ရှုခင်းသဘာဝပျောက်ဆုံးစေ
- ❑ ဒေသပေါက်ပင်နေရာကို ပျောက်ဆုံးစေ
- ❑ လူတွေကိုဒုက္ခပေး
- ❑ ဖျက်ပိုး၊ ရောဂါများအတွက် ခိုအောင်းရာ နေရာ

How do they spread by?

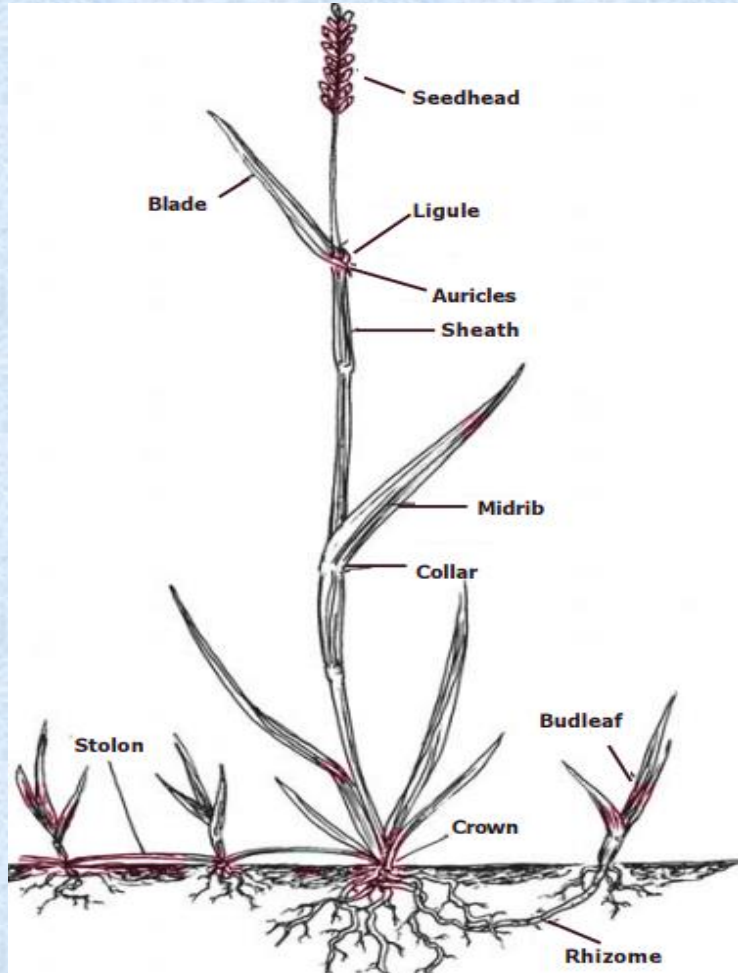
- ❑ လူ၊ ငှက်၊ အခြားတိရိစ္ဆာန်
- ❑ လေ၊ မိုးရေ၊
- ❑ ထယ်ထိုး/ ထွန်ပစ္စည်းတွေကနေ
- ❑ မြေဆွေးထည့်ခြင်း
- ❑ အပင်စိုက်ခြင်း(ဝယ်)

Identification of weed species and their life cycles will have great impact on the selection and/or success of control measures.

ပေါင်းကာကွယ်ရန် အရေးကြီးဆုံးက ?

Weed Classification - Its More Than Knowing a Name?

Weeds are classified as grasses, broadleaves & Sedges.



Anatomy of grass

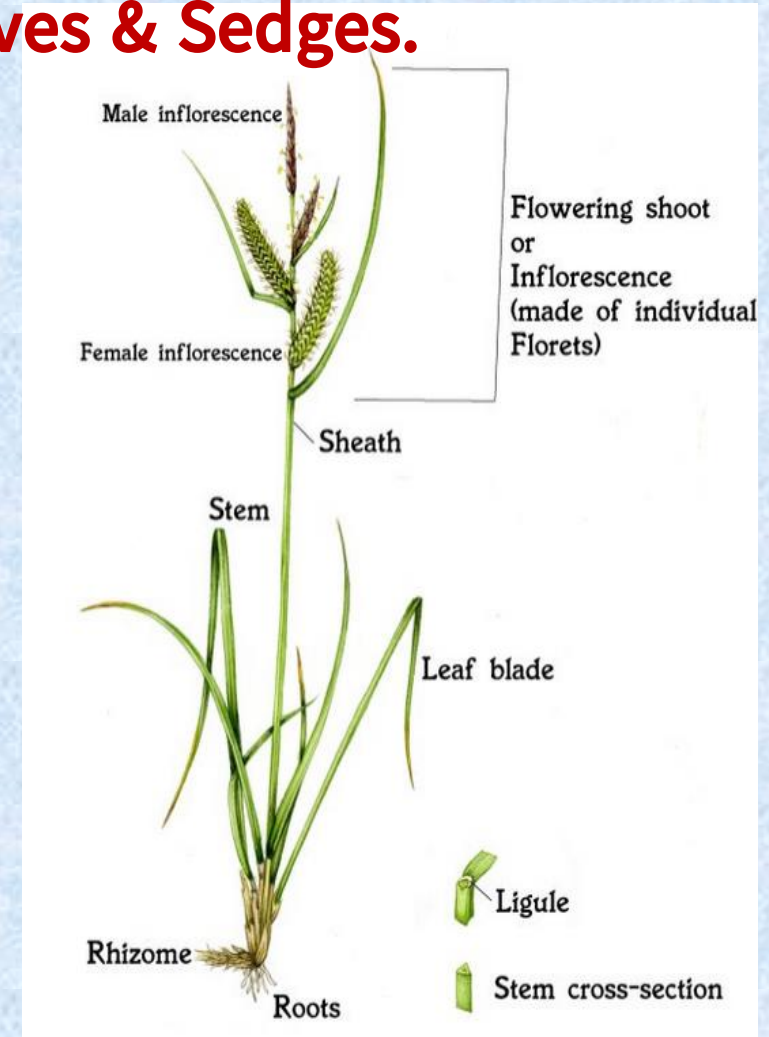


Monocot
(one seed leaf)



Dicot
(two seed leaves)

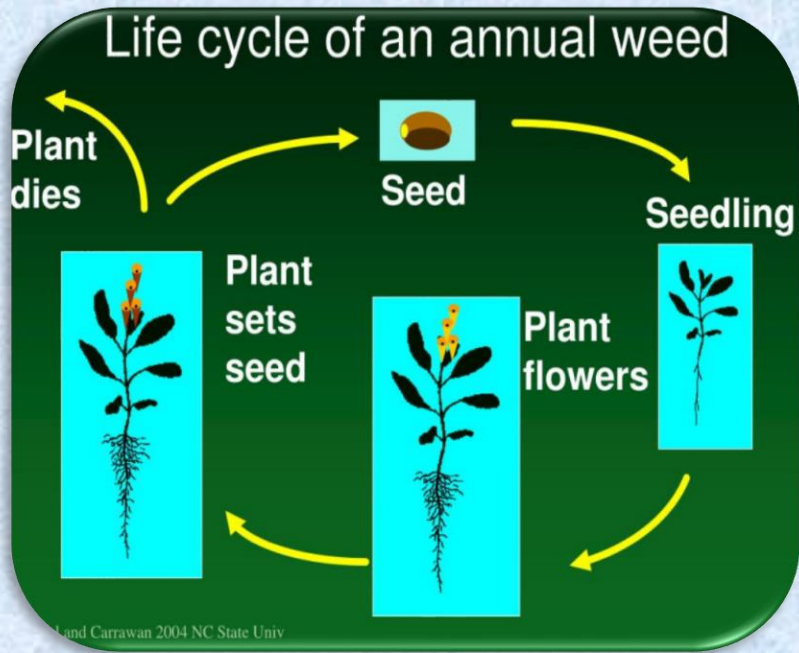
Myint Myint Tun _ Non Pesticidal Management



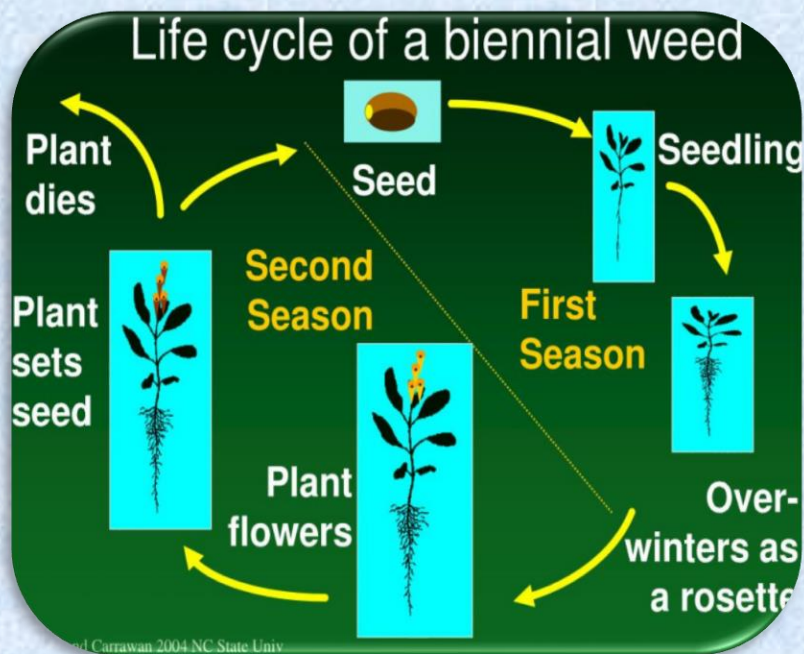
Anatomy of Sedges³²

Life Cycles of Weeds

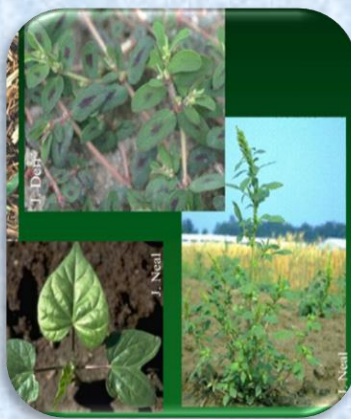
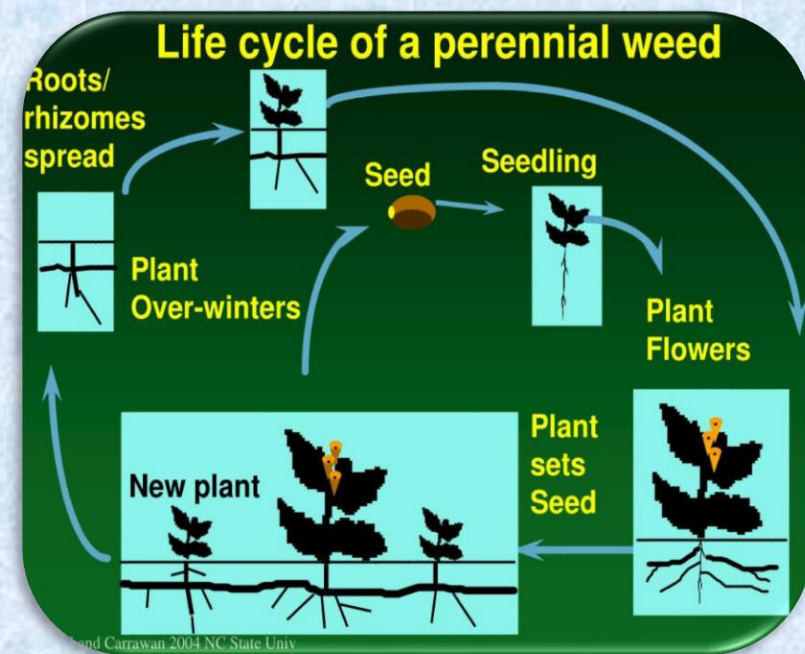
Annual weed



Biennial



Perennial



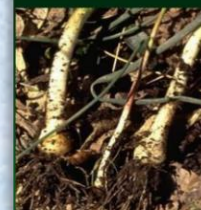
Common Biennials

- Bull Thistle
- Queens Ann's Lace
- Mullein

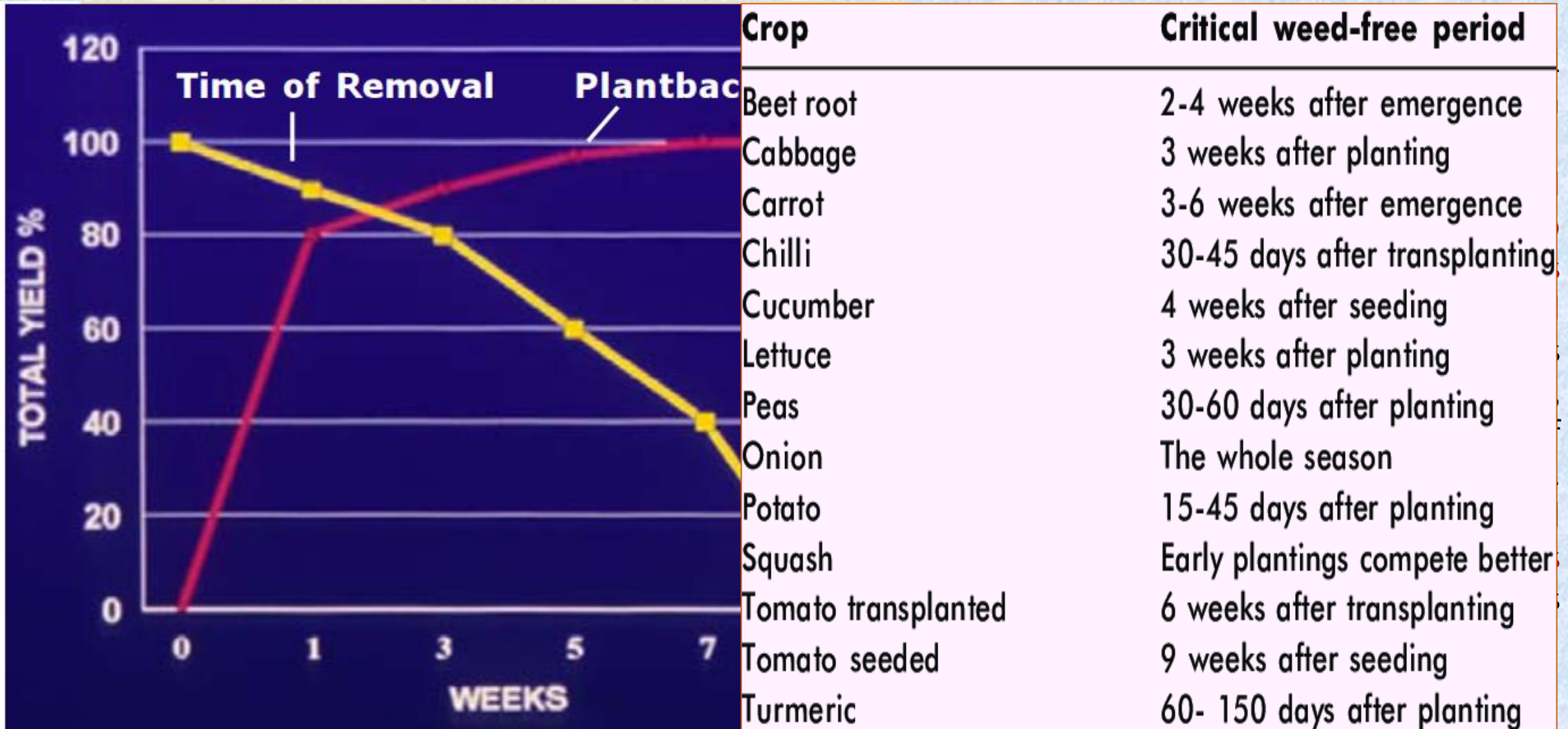


and Carrawan 2004 NC State Univ

Perennial Weeds Reproduce By:

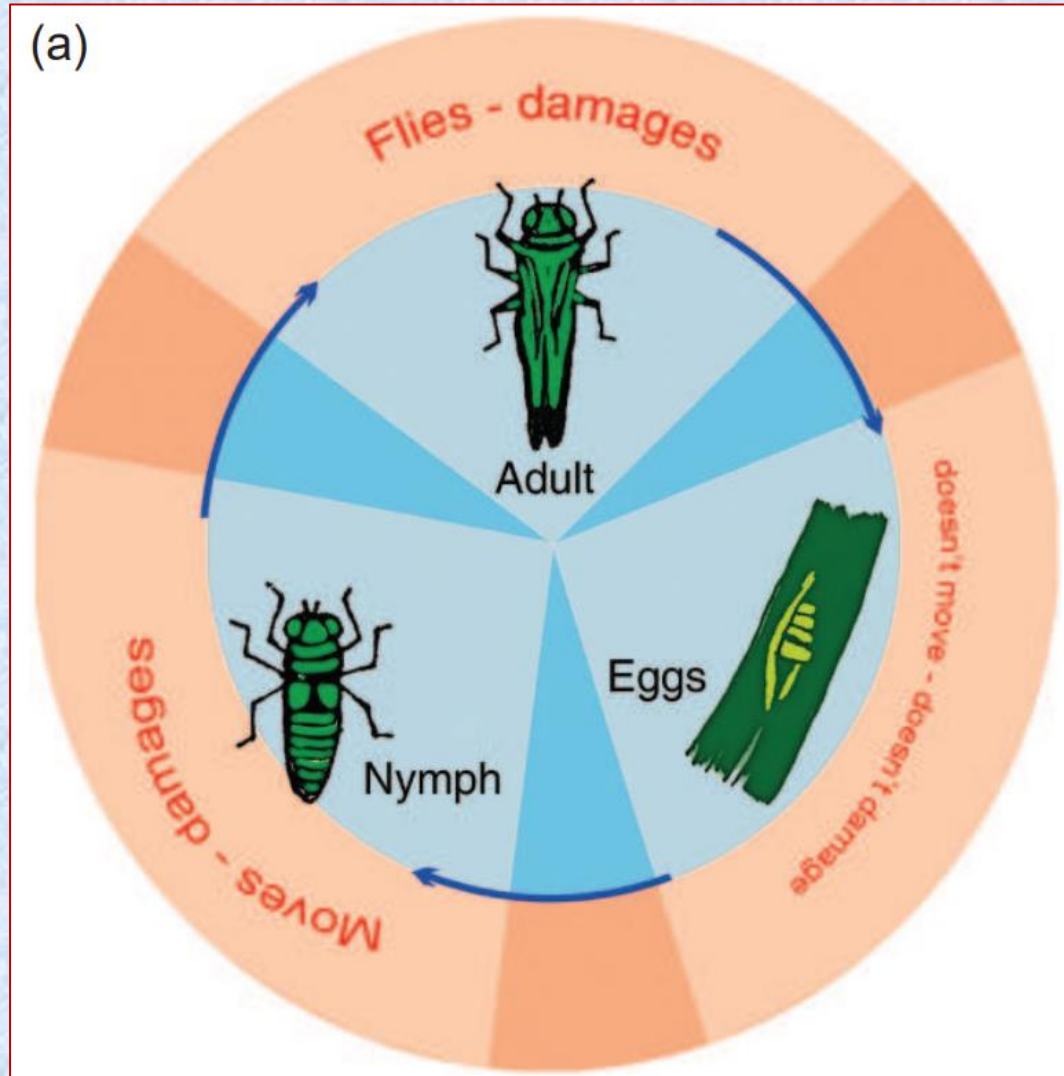


Critical Weeds Free Period?

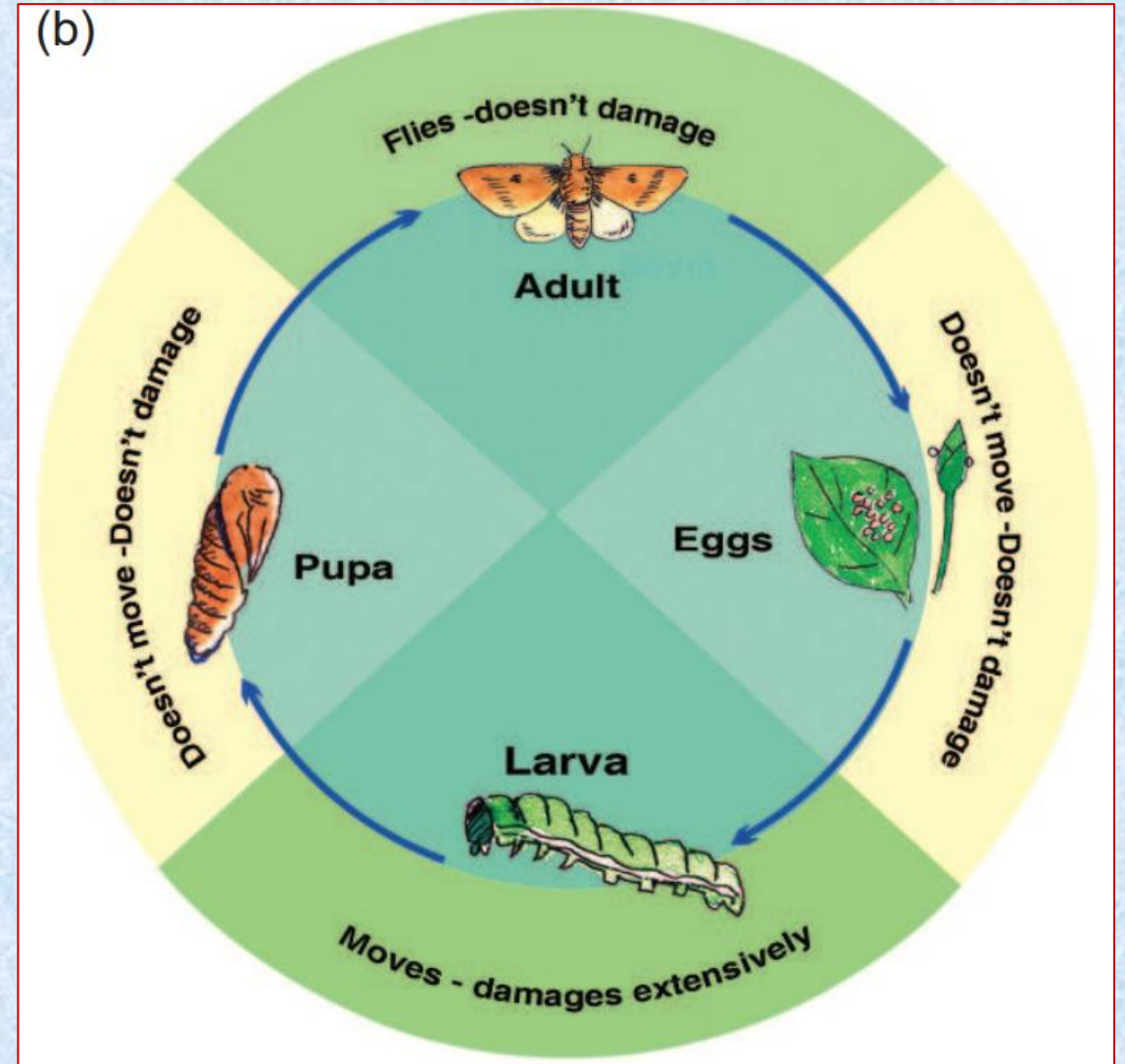


Life Cycle of Insects

Incomplete

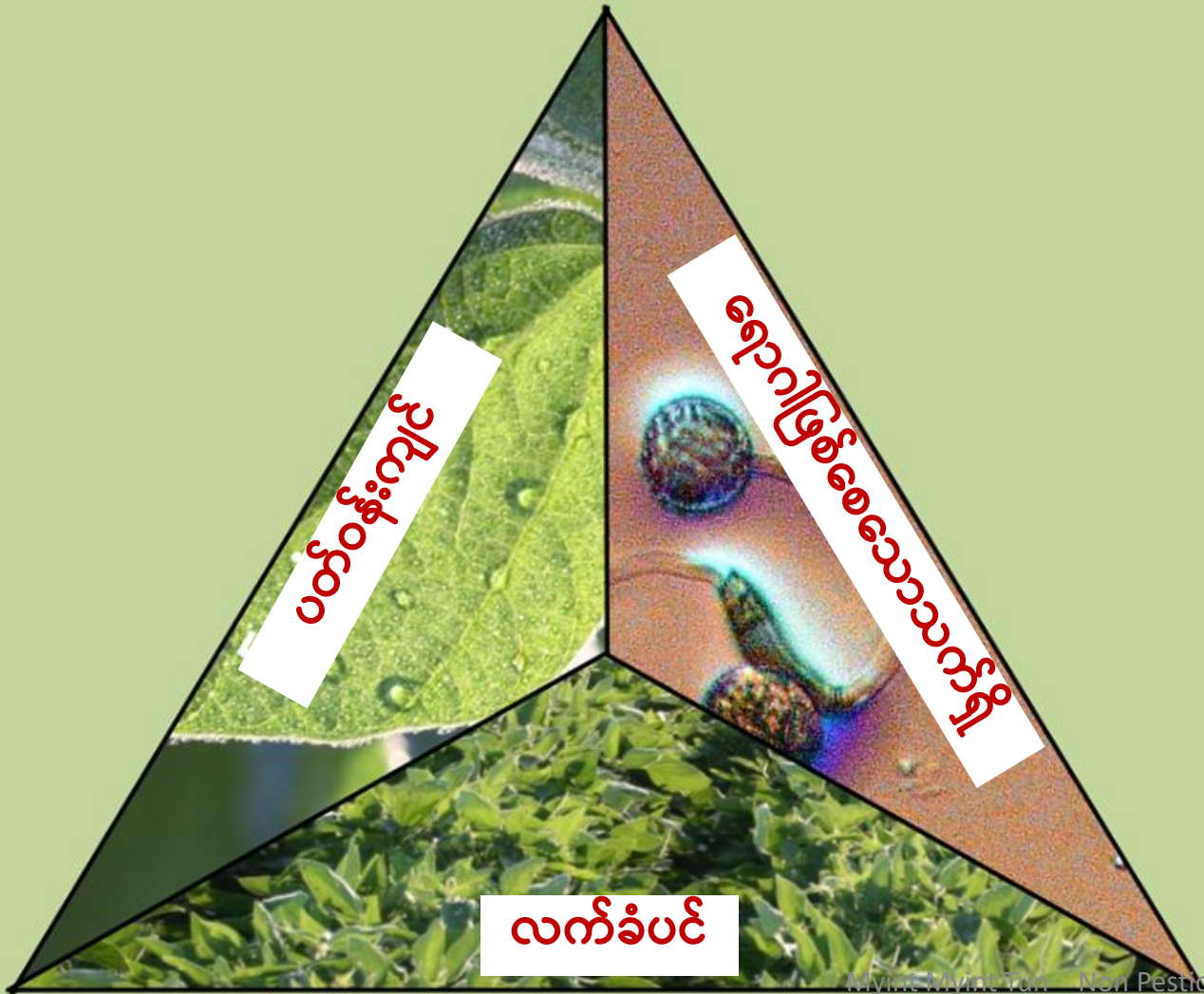


Complete

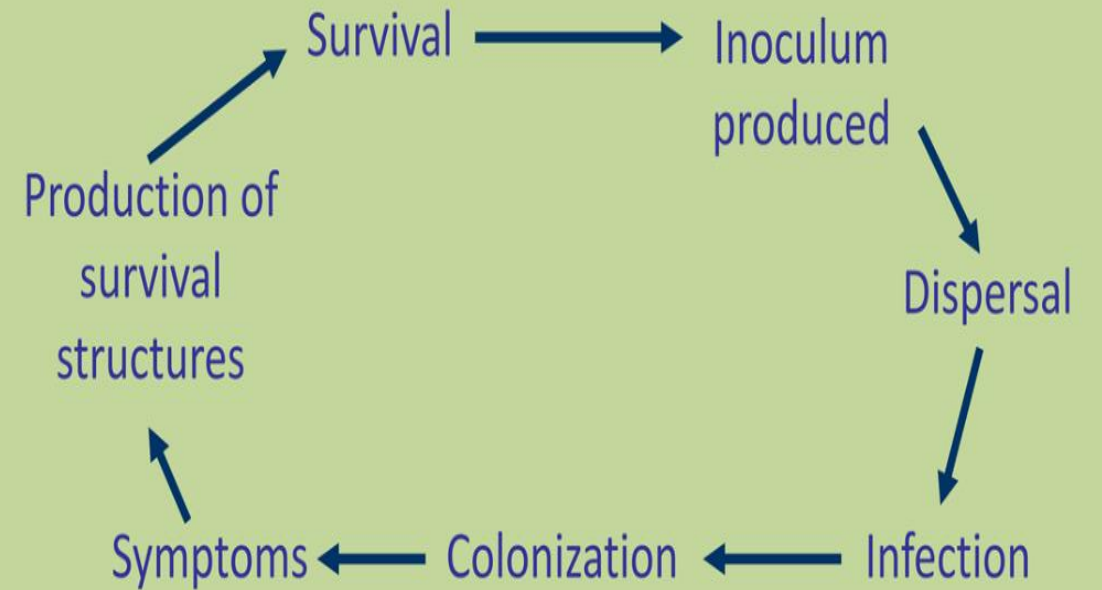


Diseases

The Disease Triangle



Disease cycle



Comparison of disease cycles

	Fungi	Bacteria	Viruses	Nematodes
Survival	Crop residue Soil Alt. hosts -	Crop residue Soil Alt. hosts Insect vectors	- - Alt. hosts Insect vectors	Crop residue Soil - -
Dispersal	Wind Rain Insects	Wind Rain Insects	- - Insects	Tillage Equipment Water run-off
Infection	Directly Wounds Insect feeding	- Wounds Insect feeding	- - Insect feeding	Directly - -

Symptom of insect pests damage and disease

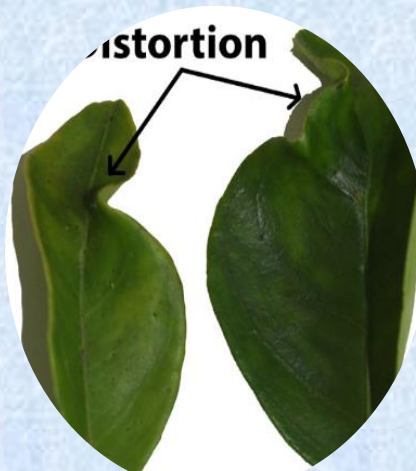
1. Chewing Insect Damage



1. Bacterial Disease Symptoms



2. Sucking _Piercing Insect Damage



2. Fungal Disease Symptoms



3. Viral Disease Symptoms



4. Nematodes

<p>Tomato Potato Sugarbeet Barley</p> <p>Root Knot (<i>Meloidogyne</i>)</p>				<p>Soybean Sugarbeet</p> <p>Syst (<i>Heterodera</i>)</p>		<p>Root Peanuts</p> <p>Lesion Nematode (<i>Pratylenchus</i>)</p>	
<p>Onion Rye</p> <p>Stem and Bulb Nematode (<i>Ditylenchus</i>)</p>			<p>Potato</p> <p>Seed-Gall Nematode (<i>Anguina</i>)</p>		<p>Wheat Seed galls</p> <p>Chrysanthemum Foliar Nematode (<i>Aphelenchoides</i>)</p>		
<p>Corn</p> <p>Stubby Root (<i>Paratrichodorus</i>)</p>	<p>Banana</p> <p>Burrowing Nematode (<i>Radopholus</i>)</p>	<p>Raspberry Rose</p> <p>Dagger Nematode (<i>Xiphinema</i>)</p>		<p>Bean</p> <p>Sting Nematode (<i>Belonolaimus</i>)</p>	<p>H D</p> <p>Stunting Decline</p> <p>Aboveground symptoms of root infection by nematodes</p>		

Nutrients Deficiency Symptoms and Pests Symptoms



A. Nitrogen



B. Magnesium



C. Sulfur



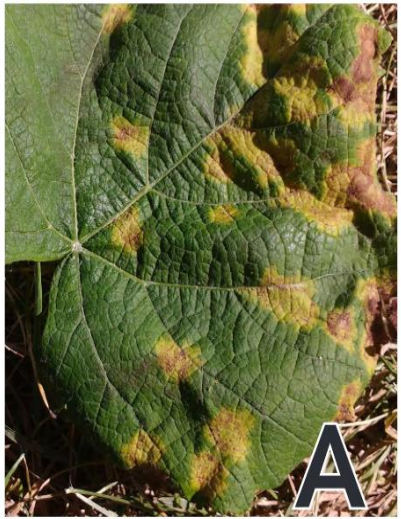
A. Mite



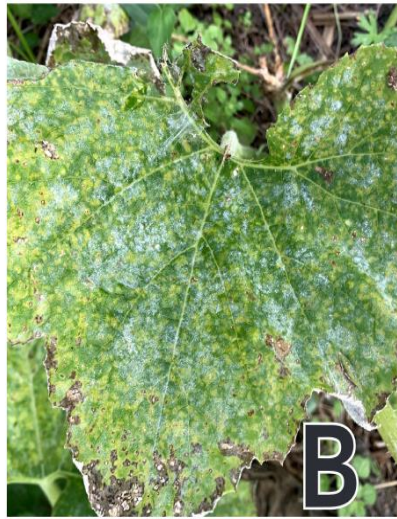
B. Nitrogen deficiency



C. Sulfur



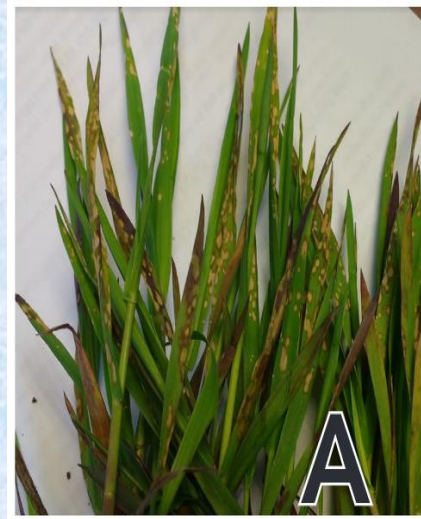
A. Downy mildew



B. Powdery



C. Lace bug



A. Herbicide drift



B. Fungal disease

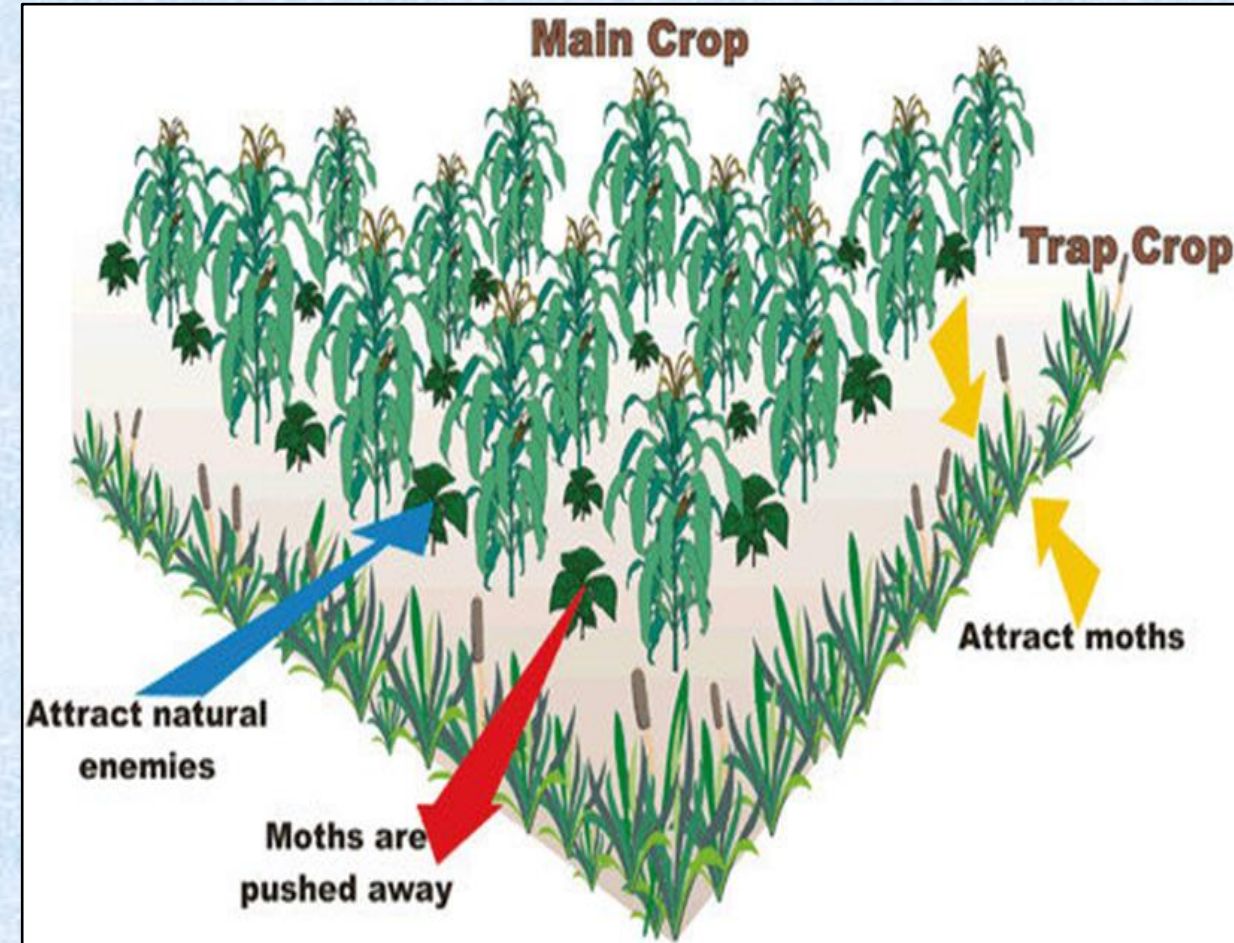


C. Magnesium Deficiency

2. Stress Enhance/ Beneficial

Trap Crops

Trap crops have been defined as “plant stands grown to attract insects or other organisms like nematodes to protect target crops from pest attack, preventing the pests from reaching the crop or concentrating them in a certain part of the field where they can be economically destroyed” (Hokkanen HMT, 1991).



Trap Crops













- ❑ Trap crops are planted **along with the cash crop** to protect it from a specific pest or several pest by attracting them for feeding, breeding and survival.
- ❑ Trap crops are generally planted **as intercropping** with the main crop, or as **a border or in strip**.
- ❑ Reduce pest incidence
- ❑ Reduce overuse of insecticides
- ❑ Conserve natural enemies
- ❑ Can be integrated with other IPM techniques













Disadvantages

- ❑ Grower need knowledge of insect behavior & migration, seasonal abundance
- ❑ Insecticide may still be needed.
- ❑ Results may be inconsistent upon weather
- ❑ Timely management of insects in trap crop is required.



Some trap crops used to manage insects/pests

Trap Crops	Main Crops	Pest Trapped	Trap Crops	Main Crops	Pest Trapped
Chrysanthemum	Filed beans	Leaf minor			
Castor or Sunflower	Groundnut	Hairy caterpillar			
Marigold	Potato, cabbage	Nematodes, snails			
Okra	Cotton	Bollworms (1:10 ratio)			

Sesame	Cabbage / cauliflower	Diamond back moth			
Sesame	Cowpea				
Sunflower	Tomato, chickpea	Helicoverpa larvae(32 plants /katha)			
Sorghum	Maize	Corn stalk borer			

Border Crop

- ❑ Plants used within or bordering a primary crop **to restrict the movement of insects /pests.**
- ❑ Border crop is planted **one month before** main crops.
- ❑ Sowing should be done **very close dense** and **minimum spacing.**
- ❑ Single or double border.

Use of trap and border crops in vegetable production



Maize



Sorghum

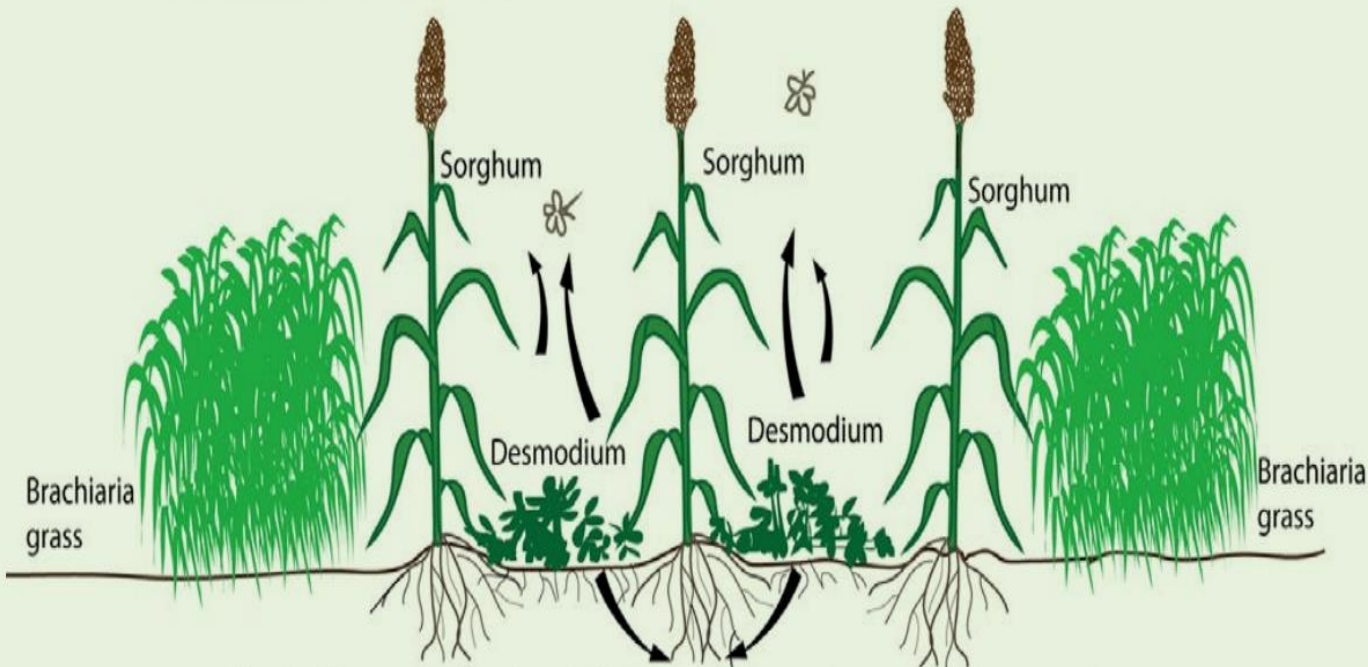
Pull – Push Fights Pests Infestation

‘Pull’

Volatile chemicals produced by border plants attract stem borer natural enemies

‘Push’

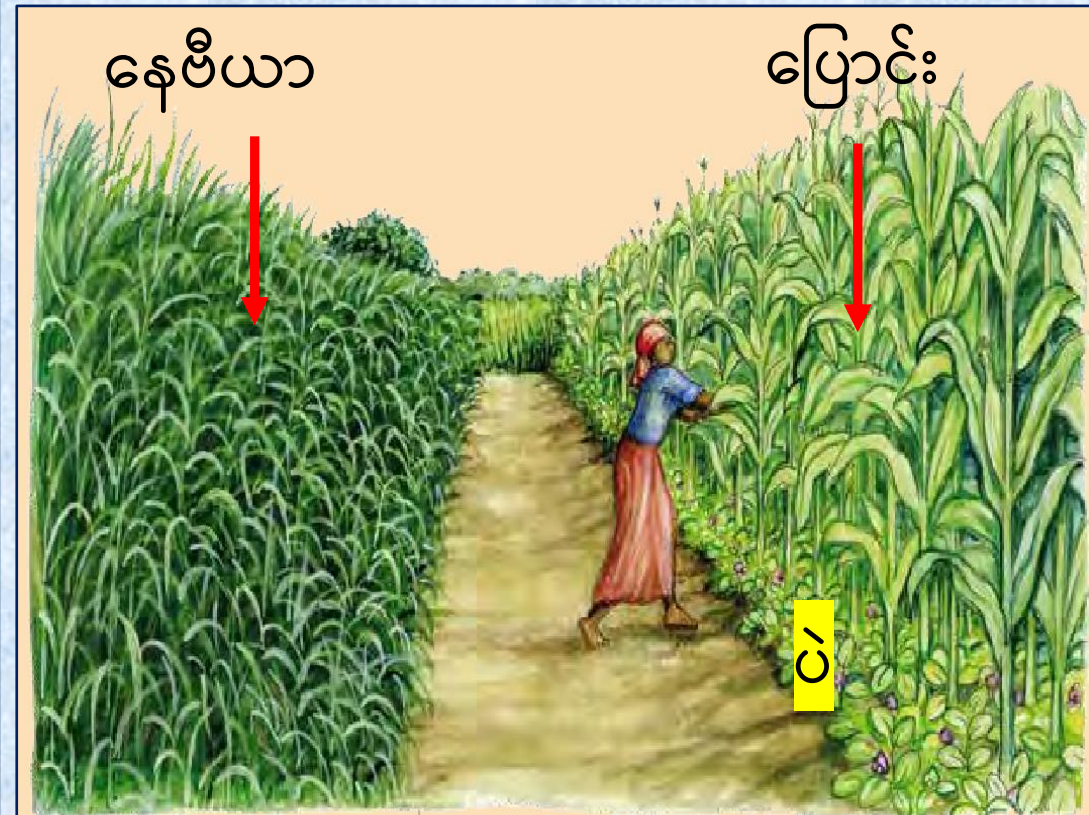
Volatile chemicals produced by intercropped plants repel stem borers and attract their natural enemies



Chemicals secreted by desmodium roots control *Striga* and deplete *Striga* seed bank in the soil

Desmodium roots fix atmospheric nitrogen in the soil; shoot and root biomass increase soil organic matter

Myint Myint Tun _ Non Pesticidal Management



Napier grass (at left) and Desmodium (at right) protect from stem borer and weeds (FAO, 2016)

Repellant Plant

Basil/Ocimum



Garlic



Radish



Nasturtium

Rosemary



Tansy

Petunia

Peppermint



Molasses grass/

Desmodium

Pests

flies, mosquito, tomato borer

beetles, aphids, weevils, spider mites, carrot fly

cucumber beetle, nematodes

aphid, beetle, squash bug

cabbage moth, bean beetle, carrot flies

beetle and flying insects

Beetles on beans

Whitefly

stem borer

Attracted Plants



Cowpea



Carrot



Marigold



Buckwheat



French bean



Alfaalfa



Mustard



Cosmos



Anise



Caraway



Dill



Parsley

Repellent Plants



Ocimum sp



Peppermint/Spearmint



Garlic

Border Plants



Maize



Sorghum 47

3. Reactive Sprays



Ginger, Garlic & Chili



Tumeric



Peppermint

Rotenone

Plants : *Derris elliptica* and *Tephrosia purpurea*, etc

Family: Leguminosae.

Extracted from : roots



Root of Derris sp



Derris elliptica



Seed/pod of *Tephrosia purpurea*



Tephrosia purpurea



Myint Myint Tun _ Non Pesticidal Management



Non pesticidal management

- ✓ **Placing perches** for insectivorous birds in the fields.
- ✓ **Deep summer plowing** to destroy the pupae of cotton bollworms, army worms and other pests whose pupae are in the soil.
- ✓ **Manual removal** of leaves that are heavily infested with pest insects.
- ✓ Cultivating Resistant Variety
- ✓ Soil Solarization
- ✓ Using inexpensive pheromone tablets to attract pest insects in order to monitor their abundance.
- ✓ Neem, chili-garlic, or cow dung/ urine are sprayed on crops only when and where they are really needed.
- ✓ Reduced excess sources of nitrogen
- ✓ Regularly **Scouting your field** (Identify, Evaluate, Prevent, Action, Monitoring & Action)

Training & Education



Ecological Engineering for
Pest Management in Rice



*“If you have healthy soil,
you will have healthy
plants that produce more.
Only by doing so can you
preserve your land for your
children.”*

ကျေးဇူးတင်ပါတယ်ရှင်



