



Integrated pest management strategies

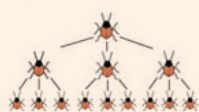
The impact of climate change on pest dynamics has become a critical concern for small-scale farmers. This pamphlet on Integrated Pest Management (IPM) equips farmers with the knowledge and tools needed to navigate the intricate relationship between climate change and pests.

IMPACT OF CLIMATE CHANGE ON PEST AND PEST MANAGEMENT STRATEGIES

Climate change, with its rising temperatures, increased carbon dioxide, and increased rains or drought, is influencing pests. It leads to more pest generations, outbreaks like the Tomato leaf miner, invasive species such as desert locusts, and challenges to host plant resistance. This requires farmers to adapt their pest management strategies.



HOW DOES TEMPERATURE INCREASE AFFECTS INSECT PESTS?



Increased number of generations



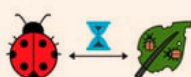
Expansion of geographic range



Outbreak of plant diseases transmitted by insects



Increased overwintering survival



Desynchronization of insects and their natural enemies



Loss of synchrony with the host plant

MAJOR INSECT PESTS AND DISEASES AND HOW TO MANAGE THEM

Major insect pests of cereals (sorghum, millet)

Fall army worm



Measures to manage pest

- Crop rotation with non-host crops
- Handpicking
- Used of wood ash
- Use of grease
- Add soil to the leaf whorls
- Intercropping
- Use neem, pyrethrins, garlic
- Push & pull technology
- Destroy crop residues
- Field hygiene
- Conserve natural enemies
- Use recommended insecticides

Stemborer



Measures to manage pest

- Crop rotation with non-host crops
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Sorghum shoot fly



Measures to manage pest

- Early sowing.
- Use of shoot fly resistant varieties
- Use of natural enemies
- Collect and destroy crop residues
- Proper weed control
- field hygiene/ sanitation
- Rotations with non-susceptible crops
- Neem seed extract

Major diseases of cereals (sorghum, millet)

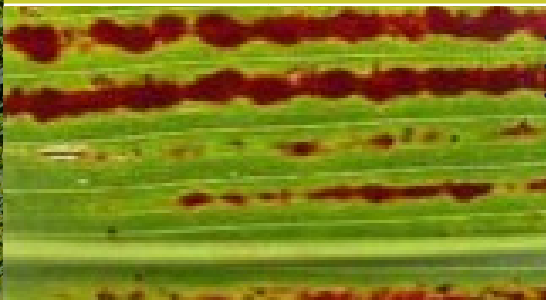
Sorghum leaf blight



Measures to manage disease

- Use disease free seeds
- Remove plant debris
- Spray mancozeb
- Treat seeds with thiram or captan

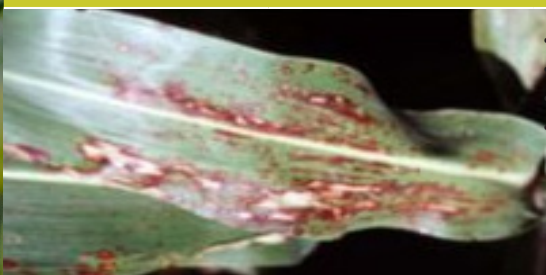
Sooty stripes



Measures to manage disease

- Rotate crops
- Plant tolerant varieties
- Destroy crop residues

Anthraxnose



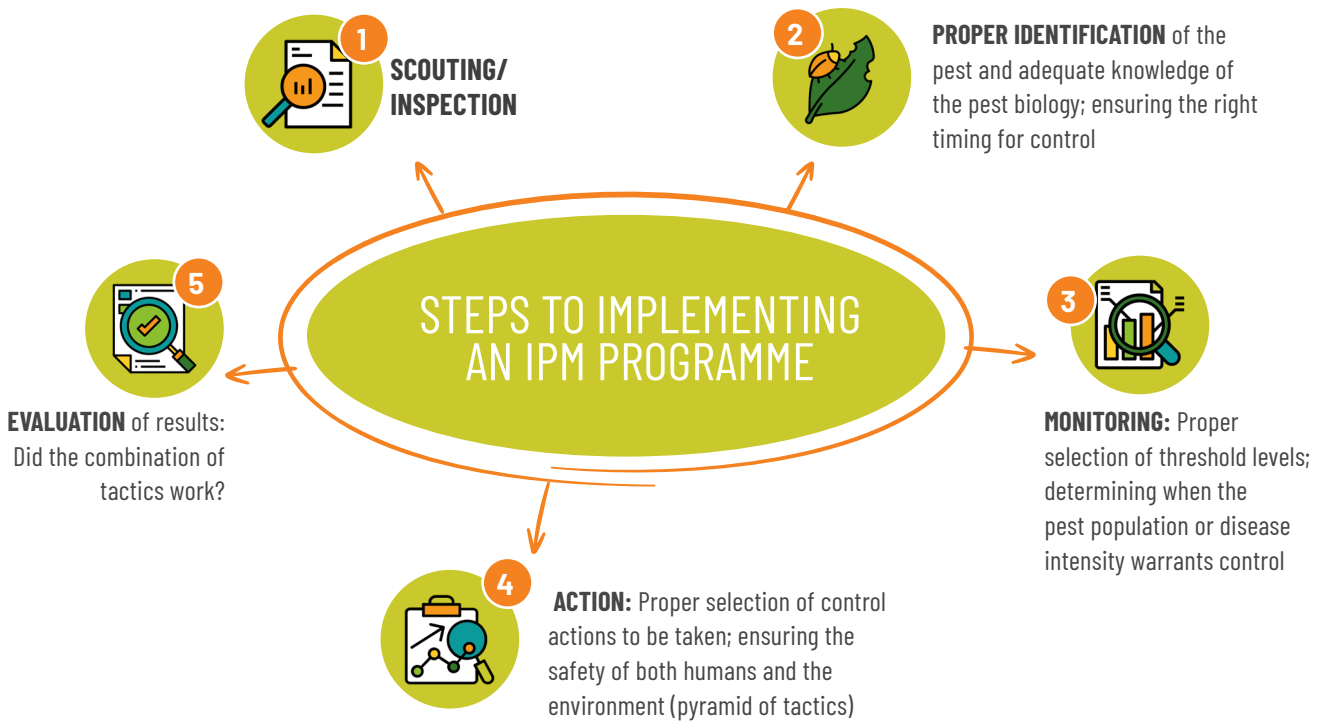
Measures to manage disease

- Crop rotation
- Plant resistant hybrids
- Treat seed with Thiram
- spray mancozeb and maneb

Major insect pests of legumes (cowpeas, green grams, pigeon peas)	
Black bean aphid	Measures to manage pest
	<ul style="list-style-type: none"> • Use sticky traps • Conserve natural enemies (lady beetle larvae and adults, lacewing larvae and adults, hover fly, parasitic wasps) • Use insecticidal soaps • Intercrop with natural insect repellent such as garlic or chilli • Use recommended insecticides
	
African Bollworm	Measures to manage pest
	<ul style="list-style-type: none"> • Scout the crop regularly • Hand picking • Neem • Bacillus thuringiensis (Bt) • Crop rotation with non-host crops • Field hygiene • Weed management
	
Foliage beetles	Measures to manage pest
	<ul style="list-style-type: none"> • Crop rotation • Delay sowing, for the crop to escape high populations. • Apply Neem, pyrethrins • Use recommended insecticides by extension agents.
	
Stem fly	Measures to manage pest
	<ul style="list-style-type: none"> • Early sowing • Collection & destruction of affected plants • Have a weed free crop • Intercropping
	
Podborer	Measures to manage pest
	<ul style="list-style-type: none"> • Crop rotation with maize • Remove crop residues • Spray Bt. • Spray with Neem
	<ul style="list-style-type: none"> • Use recommended insecticides • Intercropping with sorghum or maize
Major diseases of legumes (cowpeas, green grams, pigeon peas)	
Rust	Measures to manage disease
	<ul style="list-style-type: none"> • Seed dressing with carbendazim, thiram or microbutanil • Foliar application of copper oxychloride, mancozeb • Crop rotation • Use resistant varieties
Leaf spot	Measures to manage disease
	<ul style="list-style-type: none"> • Planting resistant varieties • Seed dressing • Crop rotation with non-host crops (non- leguminous crops) • Maintenance of field hygiene • Proper weed management
Anthracnose	Measures to manage disease
	<ul style="list-style-type: none"> • Intercropping • Plant tolerant varieties • Crop rotation • Spray fungicides

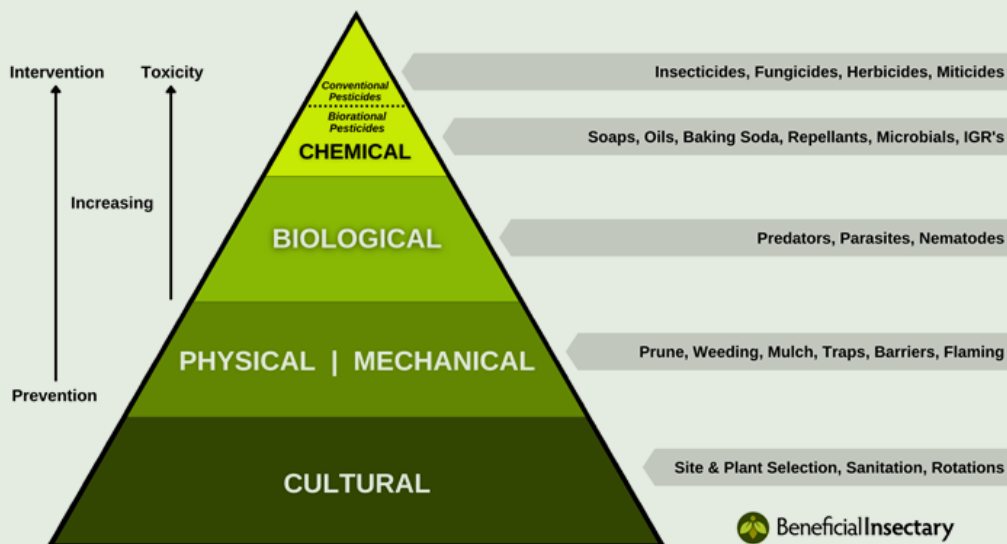
PEST MANAGEMENT

One method to manage pests is Integrated Pest Management (IPM), a holistic approach that combines various pest control methods to effectively minimise pest populations while prioritising environmental sustainability and minimising synthetic pesticide use.



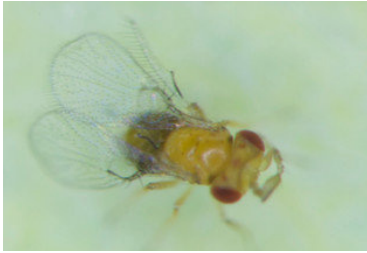


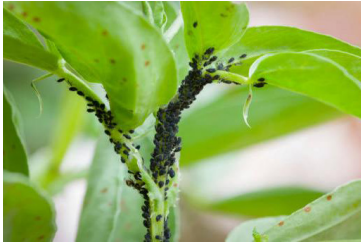




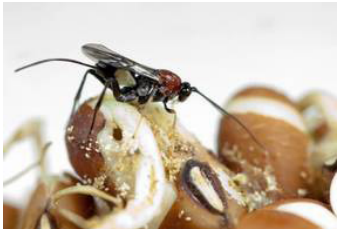

Pest management strategies

- **Prevention control measures** such as planting quality seed, appropriate plant spacing, good soil management, and proper crop nutrition.
- **Physical control measures** such as hand picking, use of sticky traps, use of abrasives, and mass trapping.
- **Biological control measures:** using natural organisms such as predators, parasites, and pathogens/disease causing organisms to control pests.
- **Botanical control measures:** using plant extracts in the control of pests which is less harmful to the environment and natural enemies.
- **Cultural control measures:** manipulation on cultural practices to reduce or avoid pest damage to crops.



IPM pyramid of tactics

1 Biological control measures

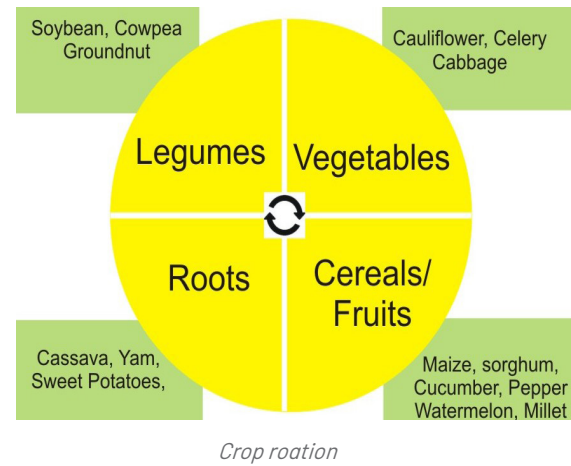
Type of natural enemy	Natural enemy	Pest controlled
Parasitoid	<i>Trichogramma chilonis</i> 	Sorghum shoot fly 
Parasitoid	<i>Aphidius colemani</i> 	Bean aphid 
Predator	<i>Macrolophus pygmaeus</i> 	<i>Tuta absoluta</i> (Tomato Leaf Miner) 
Parasitoid	<i>Cotesia marginiventris</i> and <i>Chelonus insularis</i> 	Fall army worm 
Parasitic wasp	<i>Therophilus javanus</i> 	Pod borer (cow pea) 

2 Botanical control measures

Botanical plants (Source of extract)	Pest controlled	
Neem (Mwarobaini)	Control of fall army worm, tomato borer, tomato leaf miner, caterpillar, aphids, mites, stem borer, whiteflies.	
Chilli/Hotpepper	Control of aphids, foliage beetles, pod borer, African boll worm and other vegetable pests	
Pyrethrins	Control of African armyworm , African bollworm , Aphids , Cutworms , Spider mites , Thrips , Whiteflies , Maize stalk borers, Potato jassid.	
Tephrosia vogelii	Control of cucumber beetle, leafhoppers, squash bugs, flea beetles, harlequin bug, spittlebugs, thrips, scales. Storage pests; larger grain borer, bean bruchid	
Tithonia diversifolia	Control of both field and insect pests; aphids, whiteflies, beetles, red spider mites, weevils	
Tagetes minuta (Marigolds)	Control of aphids, red spider mites, nematodes	
Rotenone	Control of aster beetles, aphids, cabbage loopers, cucumber beetles	
Spider plant, (Gynandropsis gynandra)	Control of nematodes	
Tobacco/Nicotine	Control of whiteflies, gnats, root and leaf aphids, thrips, and leaf miners.	

3 Cultural control measures

Polycultures in pest management involve diverse planting strategies such as mixtures of varieties, intercropping, and weed strips to minimise pesticide use and encourage beneficial insects. Studies suggest that crop diversification, including practices like hedgerows and trap cropping, can reduce pest abundance and damage compared to monocultures. Additionally, incorporating flower strips with specific characteristics can promote the conservation of biological control, supporting natural enemies with essential resources like shelter and food.

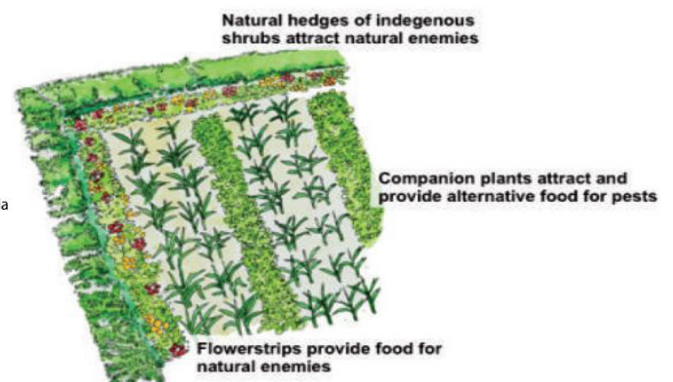
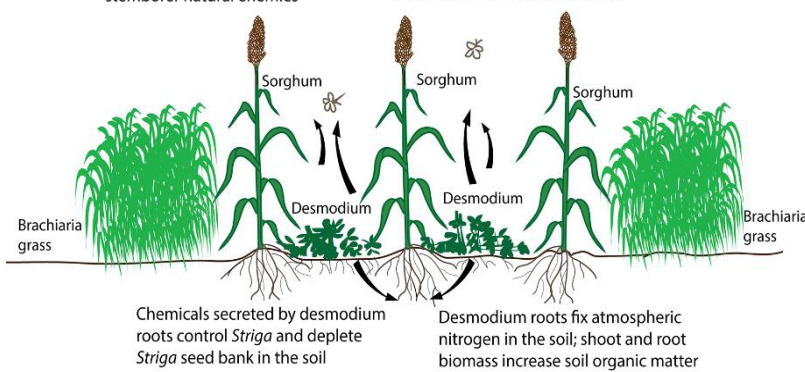


'Pull'

Volatile chemicals produced by border plants attract stemborer natural enemies

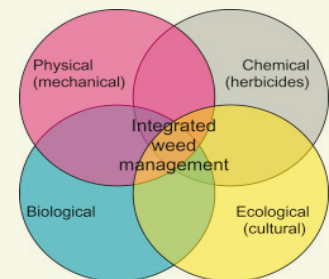
'Push'

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



WEED MANAGEMENT

Weeds are a problem in farming because they can lead to lower crop yields, make agricultural products and land less valuable, increase the costs of weed control practices, and even cause health problems or attract other pests.



Integrated weed management

- 1 **Physical prevention measures:** Maintain farm cleanliness and hygiene, use certified seeds to ensure weed-free planting, minimize weed spread through equipment and animals, and adhere to legislation and guidelines for weed control.
- 2 **Mechanical measures:** Employ primary and secondary tillage for weed destruction, use tools like hoes and ox ploughs for manual weeding, implement practices such as mowing, mulching, and soil solarization, and engage in fire or flooding as mechanical weed control methods.
- 3 **Biological control of weeds:** Introduce natural organisms like insects for weed control, for example, Cactoblastis moth for prickly pear cactus control.
- 4 **Cultural measures:** Rotate crops, alternating with broadleaf crops to disrupt weed adaptation, plant species with varied seasonal cycles, ensure seeds and irrigation water are free from weed contaminants, practice techniques like mulching, proper spacing, and early planting for weed management.

CHEMICAL WEED CONTROL (EXAMPLE SORGHUM)

- ▷ **Pre-emergence** herbicides like acetochlor and atrazine are applied after sorghum planting to control grass weeds, while Atrazine is effective for both pre-emergence and early post-emergence.
- ▷ **Post-emergent herbicides**, including 2,4-D and dicamba, target broad-leaf weeds emerging between the two and four-leaf stage in sorghum.
- ▷ **Pre-planting herbicides**, such as Paraquat and Glyphosate, require strategic planning, leaving the land bare for up to six months before sorghum planting to control common couch, fleabane, and Johnson grass.

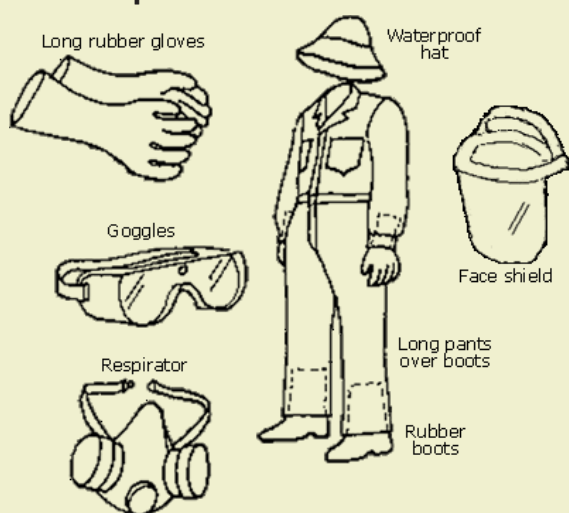
Precautions for pesticide selection

When purchasing pesticides ensure to select from the least toxic to the most toxic for both human and environmental safety.



Chart showing WHO classification of pesticides

Safe use of pesticides



Symptoms of pesticide poisoning

- Excessive salivation, sweating and tearing.
- Muscle twitching, weakness, tremor, incoordination.
- Headache, dizziness, nausea, vomiting, abdominal cramps, diarrhoea.
- Respiratory depression, irritation, tightness in chest, wheezing, productive cough, fluid in lungs.



Storage of pesticides & disposal

- Store pesticides out of reach of children and where there is no chance of contact with human food or livestock feeds.
- Do not store herbicides with insecticides and avoid cross contamination.
- Storage areas should be locked.
- Keep chemicals in their original containers, never in unmarked containers or bottles used for food or drink.
- Follow proper container disposal methods. All containers should be triple rinsed, or pressure rinsed, punctured to render the container non-reusable, and delivered to designated disposal sites.

Monitoring your farm for pest incidence is crucial, and this should commence immediately after germination. When implementing a pest management programme, it is essential to prioritise both efficiency and environmental safety. Reserve the use of synthetic pesticides as a last resort, exploring alternative methods first. Intercropping with mutually beneficial crops, offering both nutrient and pest management benefits, is a wise strategy. In conclusion, polycultures emerge as the optimal choice, providing a harmonious combination for pest control and contributing to a balanced ecosystem.