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*Shaping Lives...
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Lecture – 25, 26 & 27

FUNDAMENTALS OF PEST , DISEASE AND WEED MANAGEMENT



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- **Introduction**
- Plant protection determines the effectiveness of other inputs
- Exclusive reliance on synthetic inputs resulted in-
 - Resistance
 - Resurgence
 - Residues
 - Environmental pollution



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- **Integrated plant protection**
- Ideal combination of agronomical, biological, chemical, physical and other methods against pests, diseases and weeds
- Objective-To bring down the infestation levels to EIL(Economically Insignificant Levels)



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- **Integrated disease management**
- Epidemic- Occurs widely and periodically
- Endemic-Constantly present in that area
- Sporadic-Occur in irregular intervals

Pathogen characteristics and Disease management

- Host specificity and mobility are main characteristics of pathogen determining disease management
- Host specific and not mobile – Cropping systems
- Not host specific and not mobile- Crop rotations



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Principles of IDM

- Avoidance
- Exclusion of inoculum
- Eradication
- Protection
- Disease resistance



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Integrated Disease management

- Strategic preventive measures
- Tactical preventive measures
- Disease control measures



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Avoidance of pathogen sources

- Proper selection of geographical area
 - eg- No Bajra in wet areas due to smut
- Proper selection of field
 - eg- Late blight of potato
- Adjusting time of sowing
 - eg- Rhizoctonia root rot is more severe soon after rains in sorghum and Stem rust of wheat is more in late sowing
- Disease escaping varieties
 - eg- Early maturing varieties can escape the damage due to stem rust



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- Proper selection seed and planting material
eg- loose smut of wheat, bunchy top of banana, panama wilt etc



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Crop Rotation

- Continuous cultivation of the same crop in the same field helps in the perpetuation of the pathogen in the soil
- Soils which are saturated by the pathogen are often referred as **sick soils**
- To reduce the incidence and severity of many soil borne diseases, crop rotation is adopted



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Tillage

- Ploughing the soil during summer months expose soil to hot weather which will eradicate heat sensitive soil borne pathogens.
- In case of *Fusarium* head blight reduced tillage increasing the FHB risk .

Soil suppressiveness

- Application of organic amendments like saw dust, straw, oil cake, etc., will effectively manage the diseases caused by *Pythium*, *Phytophthora*, *Verticillium*, *Macrophomina*, *Phymatotrichum* and *Aphanomyces*.
- *Beneficial micro-organisms* increases in soil and helps in suppression of pathogenic microbes



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Tactical preventive measures

- Resistant varieties
- Removal of crop residues from field : This help in the management of soil borne facultative saprophytes as most of these survive in plant debris
- Rouging: Removal of diseased plants or their affected organs from field, which prevent the dissemination of plant pathogens
- Eradication of alternate hosts will help in management of many plant diseases.



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- **Healthy seeds and planting material:**

Selection of seed and seedling material from healthy sources will effectively manage the diseases such as loose smut of wheat (*Ustilago nuda tritici*), *bunchy top of banana* (*Banana virus-1*).
- **Sowing time:**

Generally pathogens are able to infect the susceptible plants under certain environmental conditions. Alteration of date of sowing can help in avoidance of favourable conditions for pathogen

Ex: Stem rust is more in late sowing



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- **Crop structure:**

Close spacing raises atmospheric humidity and favours sporulation by many pathogenic fungi. A spacing of 8'X8' instead of 7'X7' reduces sigatoka disease of banana due to better ventilation and reduced humidity.



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- Hot water treatment or hot air treatment will prevent the seed borne and sett borne infectious diseases.
- Hot water treatment of certain seeds, bulbs and nursery stock is done to kill many pathogens present in or on the seed and other propagating materials.
- Hot water treatment is used for controlling sett borne diseases of sugarcane [whip smut, grassy shoot and red rot of sugarcane (52°C for 30min)] and loose



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Disease control methods (physical)

- Hot water treatment or hot air treatment will prevent the seed borne and sett borne infectious diseases.
- Hot water treatment of certain seeds, bulbs and nursery stock is done to kill many pathogens present in or on the seed and other propagating materials.
- Hot water treatment is used for controlling sett borne diseases of sugarcane [whip smut, grassy shoot and red rot of sugarcane (52°C for 30min)] and loose smut of wheat (52°C for 10 min)



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Disease control methods (biological)

- Biological control is the reduction of inoculum density or disease producing activity of a pathogen or a parasite in its active or dormant state by one or more organisms accomplished naturally or through manipulation of the environment of host.



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Biological control

- Competition- Siderophores
- Ex: *Pseudomonas fluorescens* – (pseudobactins or pyoverdins) helps in the control of soft rot bacterium, *Erwinia caratovora*
- Antibiosis- Antagonism mediated by specific or non specific metabolites
- Antibiotics
- Bacteriocin
- Volatile compounds



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- Antibiotics: Low molecular weight
- Examples:
 - -*Gliocladium virens*-Gliotoxin-*Rhizoctonia solani* *Pseudomonas fluorescens*-produce 2,4- diacetyl phloroglucinol (DAPG), phenazines, pyocyanin
 - -Bio-save 10 and biosave 11 from *Pseudomonas syringal* control storage rot in vegetables and fruits



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- **Bacteriocins:** These are antibiotic like compounds with bactericidal specificity closely related to the bacteriocin producer

Example:

- The control of crown gall (caused by *Agrobacterium tumefaciens*) by the related *Agrobacterium radiobacter* strain K 84 is by the production of bacteriocin, **Agrocin K84**.



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- **Volatile compounds:** The volatile fraction responsible for inhibition was identified as ammonia.

Examples

- *Enterobacter cloacae* manages soil borne pathogens, viz., *Pythium ultimum*, *Rhizoctonia solani* and *Verticillium dahlia*



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Integrated Pest Management

- IPM is a pest management system that, in the context of associated environment and population dynamics utilizes all the appropriate techniques to minimize the pest population at levels below those causing economic injury



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Methods of IPM

- 1. Cultural methods**
2. Mechanical methods
3. Physical methods
- 4. Biological methods**



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Cultural methods

- Sanitation: Paddy gall fly *Orseolia oryzae* breeds on grasses such as *Panicum sp.*, *Cynodon dactylon*.
- Tillage and Intercultivation
- Systematic removal of infected parts:
 - Cutting and removal of infested parts of brinjal attacked by *Leucinodes orbonalis*
 - Clipping of tips of rice seedlings before transplanting eliminate the egg masses of stem borer



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Cultivar selection

- Adjusting planting or sowing or harvesting times to avoid certain pests
- Early planting of paddy in *kharif* and *late planting in rabi* minimize the infestation of rice stem borer
- Early sown sorghum in *kharif* reduces the infestation of shoot fly
- Timely and synchronous planting has been found to reduce bollworm damage in cotton and stem borer damage in sugarcane
- Plant population
- Manures and fertilizers



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- **Habitat Diversification-** crop rotation and trap cropping
- **Water management:**
 - Flooding of fields is recommended for reducing the attack of cutworms, army worms, termites, root grubs
 - Draining the field for controlling paddy case worm
- Pheromones(by pests): Ecto-harmones, that elicits behavioural responses from other members of sex of its own species
- Fairomones (by host)



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Biological control

Parasitoid:

Egg parasite : *Trichogramma australicum*

Early larval parasite – *Apanteles taragama*

Mid larval parasite – (Micro) *Bracon hebtor*

Prepupal parasite – *Gonizus nephantidis*

Prepupal parasite – *Elasmus nephantidis*

Pupal parasite – *Stomatoceros sulcaticutellum*,



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Integrated Weed Management

- Weed management is the application of certain principles and suitable methods that will improve the vigor and uniform stand of the crop. At the same time ignore or discourage the invasion and growth of weeds.

Methods to control

- Prevention
- Eradication
- Control



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Prevention

- Use weed free crop seeds
- Well rotten OM should be used
- Clean the farm equipments
- Keep non-cropped area clean
- Vigilance



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Physical methods

- Hand weeding
- Hand hoeing
- Spudding
- Sickling
- Digging
- Burning
- Flaming
- Searing
- Soil solarization
- Mulching



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Cultural methods

- Proper crop stand and early seedling vigour
- Crop rotation
- Planting time
- Stale seedbed
- Smother crops
- Summer fallowing
- Flooding



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Biological methods

- Classical biological control
 - Insects
 - Carp fish
 - Plant pathogen
 - Competitive plants
 - Snails
 - Mites
- Bio-herbicide philosophy



Bioherbicide

Product	Organism	Target weeds
De-vine	<i>Phytophthora palmivora</i>	Strangler vine (<i>Morrentia odora</i>) in citrus
Collego	<i>Colletotrichum gleosporoides</i>	Jointvetch (<i>Aeschynomone</i>) in rice
Velgo	<i>Colletotrichum coccoids</i>	Abutilon
Biomal	<i>Colletotrichum gleosporoides</i>	<i>Cassia obustifolia</i>
Bipolaris	<i>Bipolaris sorghicola</i>	Johnson grass
Biolophos	<i>Steptomyces</i>	Not specific
Luboa-2	<i>Colletotrichum gleosporoides</i> spp. <i>cuscuta</i>	<i>Cuscuta</i>
Dr.biosedge	<i>Puccunia coriculata</i>	<i>Cyperus exculenta</i>
ABG-500b	<i>Cercospora roadmanii</i>	Abutilon
CASST	<i>Alternaria cassiae</i>	<i>Morrentia odorata</i>



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Thank You