Overview of options for managing insect pests, diseases and weeds

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Outline

- Reasons for management

- Approaches to management

- Options for management

- Action thresholds

- Summary of the management options available
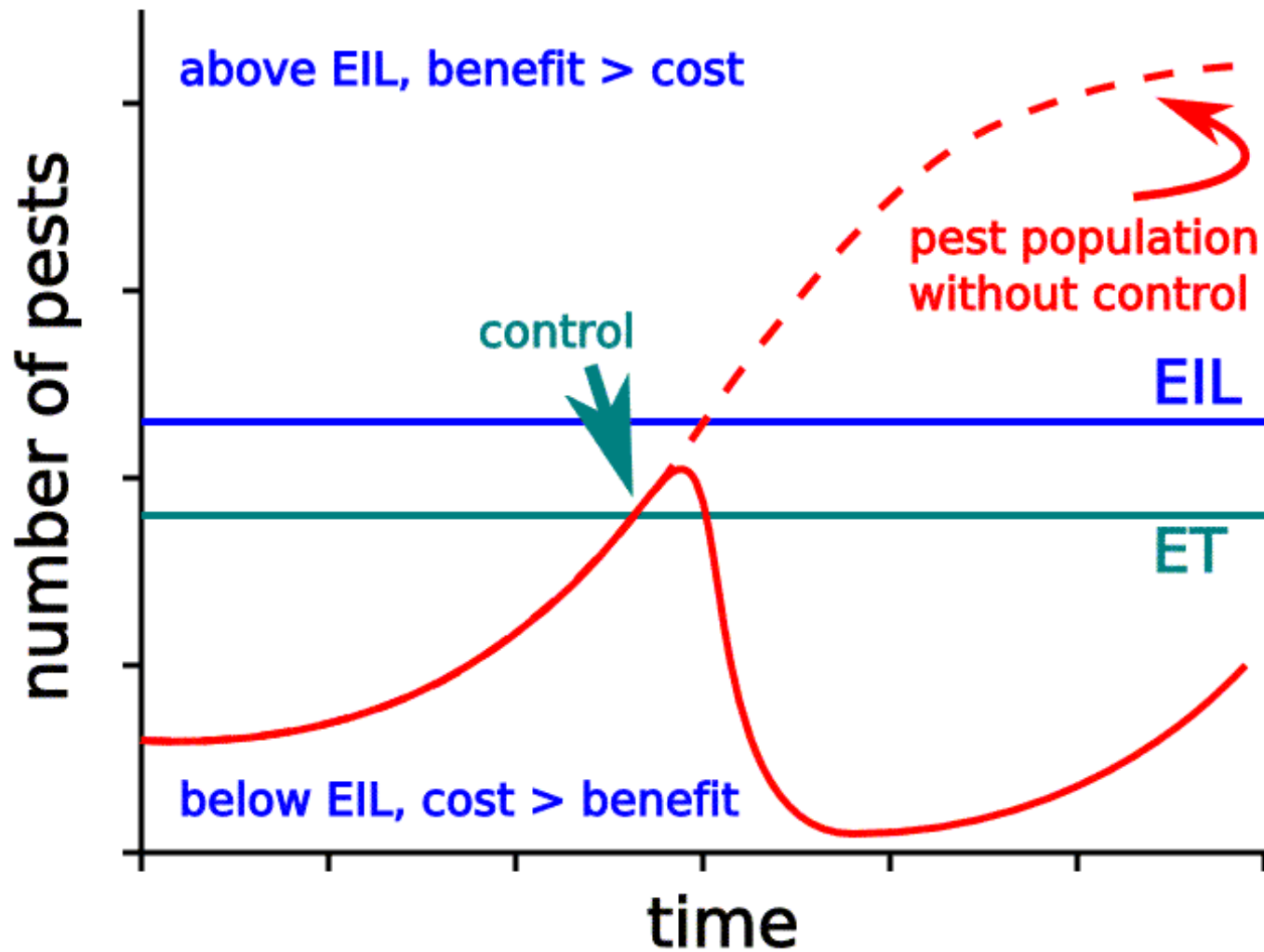
Reasons for management

- To reduce crop losses incurred from the effects of pests

- To prevent /suppress damage

- To prevent / suppress disease spread

- To prevent /suppress weeds

Approaches to management

- Host plant manipulation - isolate crop in time and space

- Reduce pathogen sources

- Manipulate vector populations

- Block disease transfer

Options for management

- Cultural practices

- Physical/mechanical

- Biological

- Host plant resistance

- Chemical

- Genetic control

- Legislative

above EIL, benefit > cost

number of pests

control

pest population without control

EIL

ET

below EIL, cost > benefit

time

EIL definition "the pest population at which pest control measures must be taken to prevent the pest population from rising to the economic injury level."

Figure credit: Ed Zaborski
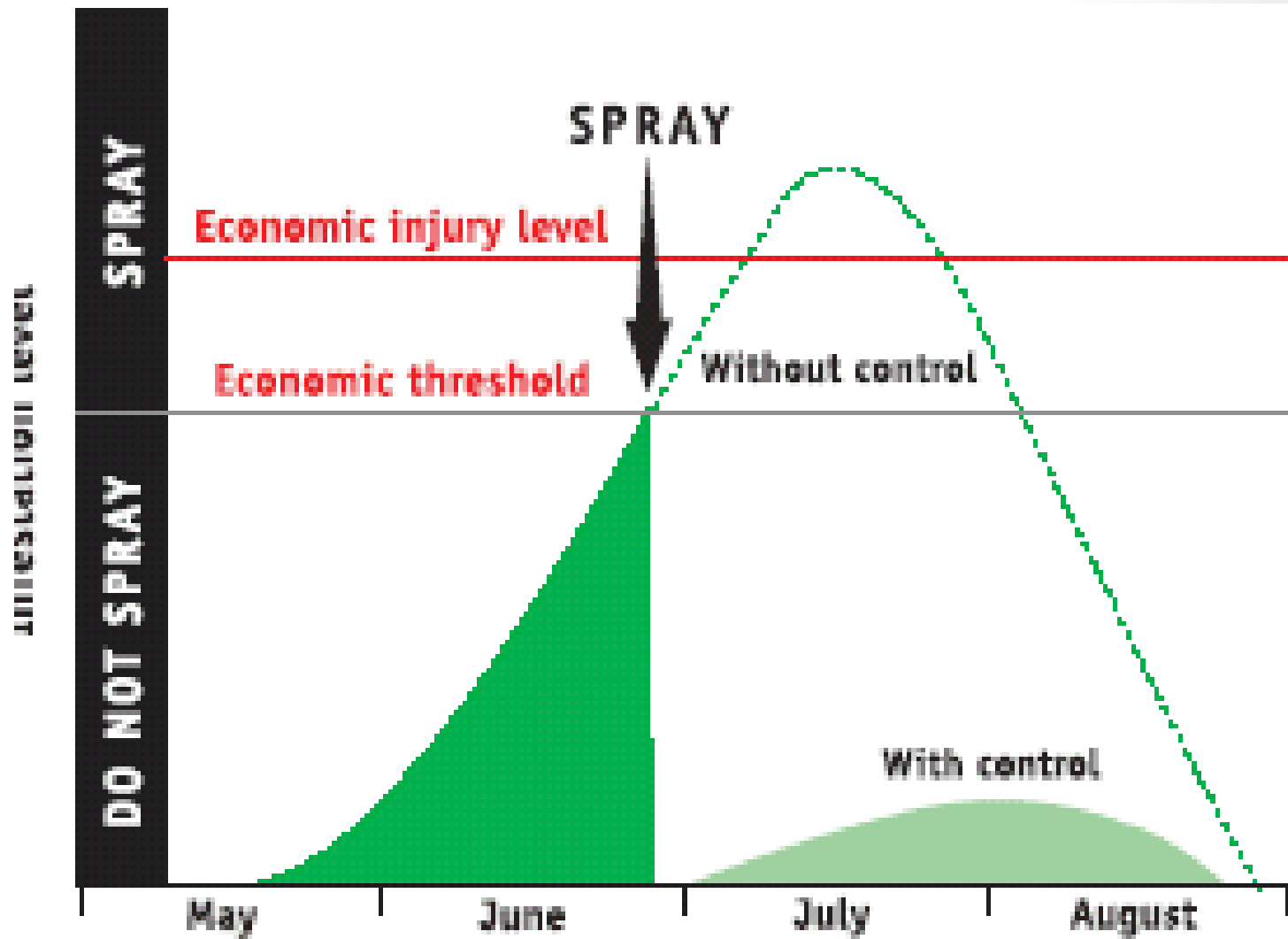
Relationship between the economic injury level
(EIL), economic threshold (ETh), and seasonal pest population
growth. The time to take control action (apply pesticide) is
when pest density reaches the ETh value; pesticide application

Action threshold

Economic Injury Level (EIL) is defined as that pest population level at which the cost of crop yield loss to the pest begins to exceed the cost of the recommended control measures for the pest.

The Economic Threshold (ET) is that level of pest population at which the pest, if left untreated, is likely to reach or exceed the EIL. Therefore, the ET is always a little lower than the EIL, and is considered the point at which the farmer should take action against the pest. Therefore, the ET is sometimes called an Action Threshold (AT).

Action threshold can be set either through experience or experiments

Cultural practices

- Activities carried out in the farm to reduce the rate at which pests colonize or affect a crop in the field

OR

- Activities that make the crop environment less suitable for pest survival

- They are several: crop rotation, changing planting dates, mulching, cultivation/ tillage methods, irrigation, sanitation, soil amendment, nutrition

Host plant resistance

- The inherent ability of the crop to fight back diseases or pest infestation or withstand competition with weeds. Three levels are recognized under specified conditions

- Resistant – the crop will grow and produce acceptable yield under pressure of high pest abundance

- Moderately resistant/tolerant- the crop will grow and produce yield under pressure of high pest abundance

- Susceptible- the crop will succumb to pressure of high pest abundance with little or no yield

- **Resistance is relative. It is influenced by presence or absence of resistance genes and environmental conditions (temp, pest abundance)**

- In relation to weeds the crop is said to be competitive than the weed pressure it is exposed to

Approaches for breeding for resistance

- Antibiosis : suppression of pest growth and reproduction on a plant e.g aphids on soybean

- Antixenosis (non –preference): Inability of an insect to find and /or feed on a plant

- Tolerance: the ability of a plant to grow and yield despite pests feeding on it

AND NOW

- The ability to insert genes into plants, creating transgenic hybrids, giving a whole new meaning to plant resistance

Biological control

- Utilization of live organisms to manage pests and diseases. The organisms utilized are mainly insects, pathogens and entomopathogenic nematodes (All referred to as biological agents –BCAs). The insects are in two groups

- Parasitoids which are mainly parasites that lay eggs on/in host and develop within or on host and emerge as adults and in the process kill the host (pathogens for of parasites feed on plant to multiply)

- Predators which search and eat the prey (pests within the field)

- Pathogens : fungi able to control other fungi and insects e.g *Metarhizium, Beauvaria, Lecanicillium, Verticillium spp*, Bacteria able to control insects or other bacteria eg Bt, OR viruses able to control insects

- Nematodes: able to control insects e.g *Steinernema spp*

Biological control:

- Natural enemies of pests cause mortality;
- Can maintain pest population at below-threshold levels

Predators

Parasitoids

Pathogens

Chemical control

- Products/materials with inherent ability to poison and kill organisms (pathogens, insects , mites and nematodes). They are capable of causing harm such as Environmental pollution, harm to man and the non target organisms such as fish, bees, birds, wildlife

- Apart from causing harm, a resurgence of pests is likely to occur, resistance of pests to certain molecules is likely to occur,

Problems with insecticides:

- Kill or disrupt natural enemies
- may be the cause of Secondary pests
- Leave Residues on produce
- Build-up of resistance – insecticide "treadmill"
- Environmental concerns (health to man and non-targets)

Chemical control

Desired chemicals for use should have the following characteristics :

- Least toxicity to man and environment,

- Be most specific to the target pest and

- Least harmful to non-target organisms

Physical/mechanical

Use of physical means to prevent pests from reaching the target crops such as

- Border crops
- Nets,
- Trenches,
- Traps
- Pruning
- Sticky barriers
- Cover crops
- Change of temperature

Border cropping or strip cropping or habitat manipulation

Genetic control

- Changing the genes within the pest or pathogen to ensure that its survival rate and reproduction is minimal

- In insects there is a technique referred to as Sterile insect technique where the insects reared in the laboratory are sterilized using radiation or a special chemical.

- The sterile insects are then released in the environment (agro-ecosystem) to breed with others with a hope that no progeny will be produced thereby reducing the pest population. E.g. fruit flies infesting fruits, tsetse flies that bite and spread trypanosomiasis in animals especially cattle

Legislation

- Use the law of the land to prevent entry and spread of pests and diseases in an area.

- It is applied when certain pests are declared quarantine pests/invasive species

- Quarantine pests are those pests that are not within an area/ country and the introduction is likely to affect the economic standing of the area or country

- The pest is likely to invade and replace other s (biodiversity)

- The pest is likely to spread and replace others and change the whole environment where a country is unable to cope

Considerations for Choosing Control Methods

- Determine damage level you can withstand
- Determine desired control outcomes
  - Prevention of pest outbreaks
  - Suppression to acceptable level
  - Eradication of all pest organisms
- Manage pesticide resistance
- Estimated costs
  - Monetary
  - Environmental impacts

THANK YOU