

Lecture 22 : STERILITY METHODS - DEFINITION - PRINCIPLES - METHODS - REQUIREMENTS AND LIMITATIONS

Sterility method - Definition

Control of pest population achieved by releasing large number of sterilised male insects, which will compete with the normal males and reduce the insect population in subsequent generation.

It is usually referred as SIT (Sterile insect technique) or SIRM (Sterile insect release method)

Sterile insect release method is a genetic control method. This is also called Autocidal control since insects are used against members of their own species.

E.F. Knipling in 1937 in South East USA used the SIRM technique to control the screw wormfly (*Cochliomyia nominivorax*) a serious livestock pest.

The sterile to fertile male ratio, called S:F ratio is important, as the reduction in reproductive potential of natural population depends on S:F ratio.

The mating with the sterile males will produce inviable or sterile eggs.

Trend of hypothetical population subjected to SIRM

Assumption

1. Female:Male ratio 1:1
2. 1 female produces 5 females as off spring in one generation

<i>Generation</i>	No.of females without releases	No.of sterile males released	No.of females releases(9:1)	Ratio sterile to normal males	No. of fertile females
1.	1,000,000	9,000,000	1,000,000	9:1	100,000
2.	5,000,000	9,000,000	500,000	18:1	26,316
3.	25,000,000	9,000,000	131,579	68:1	1,907
4.	125,000,000	9,000,000	9,535	944:1	10
5.	625,000,000	9,000,000	50	180,000:1	0

In suitable circumstances sterile male release method (SIRM) can be more effective, compared to insecticide application.

Comparison of SIRM with insecticide - Trend of hypothetical population

Generation	No. of females with no treatment	No. of females with sterile release (9:1)	No. of females with insecticide (90% kill)
1.	1,000,000	1,000,000	1,000,000
2.	5,000,000	500,000	500,000
3.	25,000,000	131,579	250,000
4.	125,000,000	9,535	125,000
5.	625,000,000	50	62,500
6.	3,125,000,000	0	31,250

SIRM technique can also be used after insecticide application which will be more effective.

Circumstances for using this method

1. Against well established pest when their population density is low
2. Against newly introduced pest
3. Against isolated population as in island
4. Combined with cultural and chemical methods

Methods of sterilization

1. Chemosterilants: Any chemical which interfere with the reproductive capacity of an insect.

a. Alkylating agents

They inhibit nucleic acid synthesis
 inhibit gonad development
 produce mutagenic effect
 (e.g.) TEPA, Chloro ethylamine

b. Antimetabolites

Chemicals having structural similarity to biologically active substances. They interfere with nucleic acid synthesis. e.g. 5-Fluororacil, Amithopterin

Methods of sterilization - continued

II. Irradiation

Irradiation done by exposing insects to α , β , radiations, X rays and neutrons. Of these, γ -radiation by ^{60}Co (cobalt) with its half-life of 60 years is the most common method.

Irradiation causes following sterility effects in insects

Infecundity Aspermia

Inability to male

Dominant lethal mutation

Radiation dose required for different species and stages for sterilization (expressed as rads - radiation absorbed dose).

Insect	Stage	Dose
Housefly	2-3 day pupae	3000 rads
Screw worm	5 day pupae	2500 rads
	1 day adult	5000 rads

Sterilizing natural population

In this method, instead of releasing sterilised males into the field, a chemosterilant is sprayed in field like insecticide. The chemosterilant sterilizes both male and female. These do not produce offspring-equivalent to killing them.

Bonus effect: The bonus effect of this method is that the sterilized males mate with normal females and reduce their reproductive capacity.

Chemosterilants used are TEPA, HEMPA, BISULFAN, etc.

Requirements for SIRM

1. A method inducing sterility without impairing sexual behaviour of insects.
2. Mass rearing of the insects
3. Information on population density and its rate of increase
4. The released insects must not cause damage to the crops, livestock or human beings
5. Good intermingling of released and natural population
6. Releasing sterilized insects when the wild population is abundant
7. This method is effective against newly introduced pest or isolated insect population as in island.
8. There should be high sterile to fertile (S:F) ratio for quicker control.

Limitations of SIRM

1. Not effective against insects which are prolific breeders
2. Sterilizing and mutagenic effect of chemosterilants and irradiation cause problem in higher animals and man (Carcinogenic and mutagenic)