

Concepts of Balance of Life

Balance of life in nature is the **maintenance** of a more or less fluctuating population density of an organism over a given period of time **within certain definite upper and lower limits** by the action of biotic and abiotic factors

Factors Contributing to Population Increase

‘Biotic potential’- extent to which a species can multiply in a given period of time if no adverse factors interfere and is also known as **‘Maximum reproductive power’**.

This concept was first introduced by **R.N. Chapman in 1928**

$$\text{B. P.} = P (f s)^n$$

Where, P=Initial population, f=Fecundity, s = Sex ratio, n = Number of generations in unit time

The biotic potential or innate capacity to increase depends on

- 1) **Initial population:** more the initial population, more will be its progeny
- 2) **Fecundity:** more the fecundity more will be the resultant population
- 3) **Sex ratio:** It is the ratio of females to the total population

Up to a limit the more the proportion of females, the more the multiplication capacity

- 4) **Number of generations in an unit time:** greater the number of generations in a unit time the larger will be the resultant population.

- Mustard aphid has over **40 generations** a year
- If all survive, a single pair of house flies may produce **191, 010, 000, 000, 000, 000, 000** flies from April to August which if spread over the entire earth form a layer **about 14 meters** deep
- Similarly a progeny of a pair of Drosophila flies produced in a year would cover the whole of Indian subcontinent and Myanmar with a solid cake of flies

Factors Tending to Reduce Populations:

These are (1) Abiotic or climatic factors and (2) Biotic factors.

These biotic and abiotic factors are known as the **constituents of environmental resistance** which always tend to destroy a considerable proportion of insect life known as **‘Normal Coefficient of destruction’**

$$Q_n = 1 - (1/s)^n / f^n$$

Where, ‘Q’ = the coefficient of destruction, ‘s’ = the sex ratio when population is taken as 1
n = the number of generations in a unit interval of time and ‘f’ = fecundity

Balance of Life

In nature there are two sets of tendencies namely the biotic potential tending to increase the population and the environmental resistance tending to reduce the population. As such there is a constant interaction between these two opposing forces and then maintains a dynamic equilibrium known as **‘Balance of life’**

Causes for Outbreak of Pests in Agro-ecosystems

1. Excessive use of nitrogenous fertilizers:

- luxuriant growth of the crop
rice and cotton show higher incidence of **yellow stem borer and sucking insects like aphids, whiteflies and leafhoppers**
- vulnerable to insect attack
- no competition for food

2. Indiscriminate use of pesticides

- secondary infestation
Continuous spraying of **carbaryl** on cotton against **bollworms** results in the **mite infestation**
- Pest Resurgence
Spraying **Pyrethroids** result in **resurgence of BPH and GLH** on Rice
- destroys the natural enemies
deltamethrin, phorate -rice destroy its natural enemies of **BPH like mirid bugs and spiders**

3. Use of high yielding varieties and introduction of new crops:

- susceptibility to pests- Minor will turn to Major pest
improved **combodia cotton**-highly susceptible to **SBW Earias sp., Boll weevil Pempherulus affinis**
Spread of the **gall midge resistant paddy** varieties **surekha and kakatiya** in **Telangana** region made other pests like **BPH, stem borer and whorl maggot** became serious pests

4. Destruction of forests and bringing forest area under cultivation:

- affects several of the weather factors
- set conditions favourable for some insects
- Forest Pests to new Crop pests

5. Monoculture:

- limitation of food gets nullified
- no competition for food and shelter

Higher incidence of **borers** when **sugarcane** crop is raised over extensive areas continuously

Cotton monocropping over large areas accentuates population of **American bollworm** **Helicoverpa armigera** and **pink bollworm** **Pectinophora gossypiella**

- Rotation with closely related crops

Cotton followed by **bhendi** increases the incidence of pests like **bollworms, aphids, mites, whiteflies** etc

6. Introduction of a new pest in a new area:

- No natural enemies

The **wooly aphid, Eriosoma lanigerum**, became a serious pest of the apple in Nilgiris as there was no natural enemy

It was brought under control only when its **specific parasitoid Aphelinus mali** was introduced from Punjab

7. Accidental introduction of foreign pests:

- adhere closely to the plants

scales and Whiteflies

- bore into the tissues of plant parts

leaf miners, stem borers, gall insects

diamond back moth *Plutella xylostella* on cruciferous vegetables

Sanjose scale *Quadraspidotus perniciosus* on fruit trees on hills

Green mealybug *Coccus viridis* on coffee

Potato tuber moth *Phthorimoea operculella*

Cotton cushiony scale, *Icerya purchasi*

Serpentine leaf miner *Liriomyza trifolii*

Spiralling whitefly, *Alerodicus dispersus*

Coconut mite *Aceria guereoronis*

8. Destruction of natural enemies:

- insecticides affect on the parasitoids and predators

DDT kills parasitoids and predators and thus encourages aphids, scales, mealy bugs and spider mites

9. Large scale storage of food grains:

- Plenty of food for stored product