HOW PESTS DEVELOP INTO EPIDEMIC PROPORTIONS

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At present, damages caused by the pests to the crops is the most important and the most serious problem faced by farmers. As a result, pest management has become the most important aspect of crop production. It is the fact that the whole group of organisms which are themselves members of the ecosystem had turned against man, as pests. Therefore, for successful management of pests, it is important to identify these pests and find out how and why they have developed into a stage to be regarded as pests.

A "pest" can be defined as an organism which could cause economic damages to the human beings and their crops and/or animals. Therefore, it is the problem of the human beings. In other words, where there is no human being there is no pest problem.

When investigating about the organisms which have become pests, it is clearly seen that all of them are compulsorily members of the same ecosystem. From the point of view of a conservationist, the eradication of any organism considering it as a pest, cannot be approved. But, a farmer tends to behave differently, considering all the organisms in his field as pests. However, an agriculturist ~~should consider~~ this condition as something between these two view points.

When a crop is established, the existing natural ecosystem changes and a limited ecosystem develops. This can be called an agricultural ecosystem. In this ecosystem the primary producer is the cultivated crop. All the living organisms feeding on it, including the herbivorous insects are the first link of the food chain while carnivorous parasites and predators consuming these herbivores are the second link and others feeding on these carnivores act as third and fourth links of the food chain respectively.

For example, the possible members of the ecosystem in a paddy field are presented in Fig.1.

Thus, all the living organisms considered as pests by us are fully entitled members of the ecosystem as any other living organism.

There are two natural forces which determine the population density of every living organism in an ecosystem. They are

1. generative force, and
2. destructive force.

The generative force is the biological ability possessed by any living organism to produce off-springs to the maximum level. This ability is known as the "biotic-potential" of the organism. If an organism produces off-springs according to its biotic potential, the earth will be covered by this species in a short time. For example, the biotic-potential of the *Drosophila* fly is 3.368 X 10^{53} per year. It means that, if a *Drosophila* fly starts to produce off-springs accoring to its biotic potential, the earth will be filled with these flies to a height of 81 feet in an year. But this does not happen practically. This is due to the destructive force acting against the generative force. The destructive force is determined mainly by the following three factors.

1. Food availability
2. Climatic factors
3. Natural enemies

All these factors are collectively known as "Environmental Resistance".

Hence, the size of the population (P) of any organism, in a given ecosystem is determined by the interaction between the biotic potential (BP)

Fig.1 : The posible members of the ecosystem in a pddy field

Rice plant --------> Rice stem borer --------> Larval parasite on stem borer
(Primary producer) (primary consumer) (herbivore) (primary carnivore) (Secondary consumer) *Trichogamma* spp.

Predatory spiders (Secondary carnivore) (Tertiary consumer) --------> Frog (Tertiary carnivore) --------> Snake and the environmental resistance (ER).

In an ecosystem, these two factors (generally act in a balanced manner) counteract each other and maintain every living population on a level, not harmful to the environment. This level is known as the "carrying capacity" of that living population.

Due to one or more reason; if the environmental resistance for a population becomes weak, the density of that living population will increase and it may become capable of damaging the environment. Then they become pests. In this way, if the population of an organism feeding on a crop increases to a vast number, and causes economic damage, the situation can be called an "incidence of pest epidemics".

It is apparent that pest epidemic status is created solely due to human activities. Some of the activities which could create pest epidemics are as follows.

* A major factor which determine the population density of an organism is the availability of food of that organism. When a cultivated crop or a stored material which makes the food of a pest becomes available through out the year, the population density of that pest increases.
* Large scale and continuous crop monocultures increases the food availability of the pests which can result in their rapid multiplication.
* When a crop is introduced into a region it may become a suitable new host plant to a certain pest. Furthermore, when breeding new varieties focusing only on yield and quality, the natural resistance of that crop can be greatly reduced. This increases the susceptibility of that crop and can result in a rapid multiplication of the pests that damage this particular crop.
* Adoption of modern agricultural practices to obtain higher yields, specially the application of large amounts of N, renders the plants more prone to be damaged by pests.
* Climatic variations occur due to large scale deforestation. These variations may favour the development and multiplication of pests. With deforestation, organisms can migrate to cultivated crops and may become pests of these crops or become pest epidemics.
* Natural enemies of a pest to a greater extend influence

the population density of that pest in a given ecosystem. They act as parasites and predators on that pests. The population densities of natural enemies and pests fluctuate around a mean level. Maintenance of pest population in this level by natural enemies is known as "biological management" of pests.

However, when chemicals are applied for the control of a pest, the natural enemies which are more sensitive to these chemicals may be completely destroyed. But, some of the pests living within the plants may survive. As there are no natural enemies to check the multiplications of these remaining pests, they rapidly multiply and may result in a pest epidemics.

In addition, the indiscriminate use of pesticides (not using the necessary concentration, the recommended chemical and improper application) may also contribute to the development of resistance in pests. Farmers use highly toxic chemicals to control these resistant pests resulting in the destruction of beneficial organisms or natural enemies, and the remaining pests multiply without any hindrance and reach harmful levels.

* Certain organisms may come into the country with plant parts or planting materials which are imported without adequate plant quarantine measures. These introduced organisms may not have natural enemies in the new environment and consequently, these organisms may multiply rapidly and results in pest epidemics.

It is apparent that with or without the awareness, due to our various activities, we have caused disruption in the existing natural equilibrium of the environment, and consequently a number of organisms in the same environment have multiplied abnormally and turned against us, as pests. But still it is not too late to correct our mistakes. What is needed is to search how and why these organisms have developed as pests and correct where we have gone wrong. This will enable use to prevent pest epidemics in the field without extra cost. Here, it is important to keep in mind that we have to work for the theme of "Pest Management" and not for the "Pest control" or the "Clean Field" concept as we believed in the past.

Having understood the current requirements of pest management, agriculturists have already identified a new concept or a pest management strategy the "Integrated Pest

Management". The objective of this strategy is to implement every possible step a farmer can take to create maximum environmental resistance to prevent any organism from reaching the economic injury level, while allowing every member living in a crop field or agro-ecosystem to survive.

BREEDING RICE VARIETIES FOR SUSTAINABLE FOOD PRODUCTION

Modern high-yielding rice varieties developed since the 1960s have been adopted on 65% of the world's riceland. Since 1965, increases in productivity coupled with expansion of the area planted to rice have doubled world rice production.

According to Dr. Gurdev S. Khush, principal plant breeder at IRRI, at present there is no more available land to bring into rice cultivation, and the growth rate of the rice production has decreased. By 2020, the rice production must be increased by 60% to feed the world's increasing population.

We have to produce more and more rice with the existing land resources or the rice farmers will start to grow on fragile hillsides and open up mangrove swamps and tidal wetlands in order to produce more.

Rice breeders play an important role in promoting agricultural sustainability. Their main challanges are increasing yield potential and yield stability, incorporating durable insect and disease resistance (using biotechnology to insert alien genes from wild rices and novel genes from other sources such as bacteria into the rice chromosome) and developing varieties that stimulate nitrogen fixation (IRRI rice variety IR42 stimulates the micro organisms to fix as much as 30-35 kg of nitrogen per hectare each year). They are trying to improve the yield potential of modern rice varieties from 8-10 tons per hectare to 10-13 tons per hectare at IRRI.

These steps will result in lesser use of inorganic fertilizers, reduced dependency on chemical pesticides, etc. protecting the environment from chemical pollution.

Rice is grown in five different ecosystems of the world - irrigated, rainfed lowland, upland, deepwater and tidal wetlands. The breeders are developing varieties for higher, stable, sustainable production for each of these environments.

It all boils down to yield increases that are environmentally sustainable.

"If we can increase the yield in good soils," Dr. Khush says "we can stop the encroachment of agriculture on hillsides, forests and mangrove swamps and protect our environment for coming generations.

Source: IRRI Reporter, March 1993.