Are Japan's cultivation techniques and the wisdom of creative Japanese farmers applicable?
– Case study of training activities at Tsukuba International Center -

Part 5: Supporting efforts to reduce pesticides use

Since 1992, improvement and development of environmentally friendly agricultural technologies has been promoting in Japan, in order to reduce the use of chemical fertilizers and pesticides. A number of technologies are being improved and developed for application, which include weeding by machinery, use of animals for weeding, use of biological pesticides (natural enemies), antagonistic plants, tunnel culture, pheromones and mulching. This has been prompted by the growing interest expressed by consumers in safe agricultural products. Consumers are aware of environmental risks and producer safety issues posed by excessive use of chemical fertilizers and pesticides applied to increase yields. In the vegetable cultivation training courses held in Tsukuba, technologies to reduce pesticides are introduced, in particular, emphasis is placed on the use of natural enemies as a means of preventing insect damage to crops, as this strategy is considered to be an effective technology to reduce use of chemical pesticides and respond to consumers' expectations. However, the technology is quite complicated and it is difficult to teach the trainees to master it. Through the farm visits, the following examples of the use of natural enemies for pesticides reduction have been introduced to the trainees.

Vegetable	Cultivation Methods	Location	Control Methods	Effects on Pesticide Reduction
Eggplant	Green house	Miyazaki	Bring in *Diglyphus* larvae that are parasitic on *Liriomyaza* damaging string beans.	Use of indigenous parasites on *Liriomyza* that damages eggplant leaves, reducing the pest density leading to reduction of pesticide use.
Eggplant	Open-field	Kyoto	Surround eggplant plots with sorghums to attract aphids which in turn attract parasitoid wasps.	The indigenous parasitic wasps that come to sorghums attach themselves to aphids on eggplant. This reduces pest density and use of pesticides.
Cabbage	Open-field	Aichi	Sprinkle sex pheromones around plots and derange communication between pests and disturb coupling, reducing the pest density.	For eradication of low density cabbage moth (*Plutella xylostella* Linnaeus), indigenous spider species (natural enemies) are used. For other pests, chemicals that nurture natural enemies are used, reducing overall use of pesticides.
Paprika	Green house	Ibaraki	1) Special entrances to the green houses that prevent pests flying in, using insect proof nets and yellow lights which insects dislike. 2) Reduction of pest density using traps with sticky tapes, and prediction of outbreaks 3) Mass release of natural enemies available in the marketplace	Prevent entry of pests through seedlings and facility entrance and control initial outbreak of pests with yellow and blue luring tapes. At the same time, observe pest density to judge the timing for natural enemy release. When the density is low, natural enemy is used for control. Once the density starts increasing, use selective pesticides, reducing overall amount of pesticides use.

In all the examples, it is understood that application of non-selective pesticides could actually increase pest numbers. This is called a resurgence phenomenon and the pest density could be higher than a situation without any application of pesticides. While natural enemies are controlling pest density, pesticides should not be used. Once the pest density starts increasing, selective pesticides that do not harm natural enemies are used. When using natural enemies for pest control, appropriate application of pesticides is highly important.

In 2008, a trainee from Mongolia conducted individual experiments on pest control methods that use natural enemies and do not rely solely on pesticides. In Mongolia, cabbage farmers were troubled by pests such as the diamondback moth (*Plutella xylostella*), the small white butterfly (*Pieris rapae*) and the cabbage moth (*Mamestra brassicae*). As a result of repeatedly applying synthetic pyrethroid, a non-selective pesticide, it has become difficult to control the diamondback moths that are reducing crop yields. In the individual experiments of the Mongolian trainee, four different sections were created in a cabbage plot, and cabbage yields and mortality rates of the moth's 3-stage larvae against the five different pesticides used in the experiment were compared. The result shows that the synthetic pyrethroid pesticides when used repeatedly in large quantities kill natural enemies and lead to a resurgence of moths and an outbreak of resistant moths, which in turn make pest control difficult.

In order to control and eliminate pests, it is essential to establish effective preventative measures for pest control and methods that enable accurate judgment in timing and application of appropriate measures. These measures could include some preventative tactics such as growing the right crops in the right areas, rotational cropping, use of low competitive varieties, selective use of pesticides, creation of desirable habitats for natural enemies with the right temperature and humidity and laying banker plants that lure their prey (pests), and appropriate application of fertilizers. Monitoring of pests and natural enemies through plot observation and accumulation of data and data analysis are critical for determining pest control measures. The combination of different techniques is also essential for reducing pesticide use. It is expected that trainees will learn about the importance of integrated pest management (IPM) from our training, and will promote this approach in their own countries.