□ '94 KSAE Int'l Symposium Paper □

韓應昆誌 34(1) : 15~19 (1995)
Korean J. Appl Entomol.

Lessons Learned and New Concepts for Farmer IPM Training from the FAO Inter-Country IPM Program

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As sustainable agriculture theory has rightly become one of the new central developments of agricultural progress, there is a need to reassess farmer and extension training programs to up-date curriculum and methodologies. One of the most important aspects of sustainable agricultural development is the essential input of local responsibility and control to match the local resource base (Berry 1977). Mass messages or 'silver-bullets' are not sufficient to deal with the tremendous levels of local variation faced by farmers, extension staff, and various levels of political systems responsible for agriculture policy. In the context of sustainable agriculture, "local" can be defined as one field with one history of management and one changing set of definable parameters (fertility, micro-climate, residue levels, weed seed density, etc.).

The nature of new agricultural technology, including improved varieties, biotechnologies, and new plant protection methods such as commercial natural enemies, pheromones, all require local management to achieve optimal economic and social benefit (Bonifacio 1994). Local management skills for a better agriculture will come from better conceptual and practical skills placed in the hands of farmers and extension staff (Flint 1981, Dover 1985). In the specific case of plant protection within the framework of sustainable agriculture, farmers must be the local managers and should possess and be able to apply a complete knowledge of their field ecosystem (Gallagher *et al.* 1994, Matteson *et al.* 1994). Future improvements in agricultural production and profitability will be possible primarily by farmers with strong ecological conceptual tools and practical skills to manage the new technologies In Asian rice production for example, raising yields from an average of 2 tons to 4 tons without destroying the underlying resource base (soil fertility, ground and surface water, biodiversity, etc) will require management of infrastructures already in place, optimizing relatively more expensive inputs, and integrating these with economic and physical constraints in areas with sub-optimal conditions for rice production Training and extension programs must deal with this reality (Matteson *et al.* 1994). A super-rice that produces 15 tons only when provided with high nitrogen, optimal irrigation, and fertile soils may increase yields in some areas (areas where the local population is already relatively prosperous due to the growing conditions and current high yielding varieties), but will the same variety help the less prosperous on less than ideal soils?

FAO INTER-COUNTRY IPM PROGRAM

The FAO Inter-Country IPM Program (ICP) has been developing IPM training programs in rice and rice-rotation crops for about 12 years. Pakistan, India, Bhutan, Nepal, Sri Lanka, Bangladesh, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Philippines, China, and the Republic of Korea currently participate in the program that is supported by the governments of Australia, Netherlands, and Switzerland. These countries are working together to promote the implementation of IPM at field level and at national plant protection system levels. In all case it has been found that theoretical changes in policy without field verification and farmer action is pointless On the other hand, field comparisons showing the benefits of IPM and the ability of farmers are pointless without changes in policies that currently favor chemical intensive agricultural methods. Thus

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the ICP focuses on field training programs in order to provide field verification of that farmers can implement IPM, and then promotes changes in policies (FAO 1993).

In this paper I will stress the lessons learned and the new concepts being implemented on a large scale for training farmers and extension staff. I will also mention new IPM plant protection policies which are being promoted.

EXISTING IPM TRAINING PROGRAMS

During the 12 years that the ICP has been implementing IPM training, there have been many false starts and many lessons learned. Perhaps the strongest lessons learned are as follows:

(1) IPM is a process - not a technology. IPM is a process of decision making in which practice is the best method of training for decision making.
(2) IPM skills and concepts are best learned in the field. *Let the field be the teacher.*
(3) Season-long training courses allow all plant, insect, disease, and weed development processes to be observed over time.
(4) Farmers must be active during training to achieve maximum interest.
(5) Trainers must not lecture, but should facilitate a process of learning.

These lessons have led to some new training methods to teach the basics of field management including production and plant protection methods and concepts. The current training process is experiential and participatory so that participants learn from their own experiences and are able to combine their previous experiences and traditional knowledge into the learning process These methods draw from extensive experiences in adult education programs, especially in the areas of adult literacy and health care. These methods allow participants to maintain control of the training so that it fits their own needs and interests. The training process assumes that the participants have extensive experience and should participate in training as partners with the trainer. The role of the trainer is to provide the proper environment for farmers to test their own perceptions and current views of nature against new ideas that are often counter-intuitive such as plant compensation, natural enemies, and disease epidemiology. IPM is thus not replacing the on going management practices of farmers, but rather building upon valid actions and introducing new methods and concepts. IPM methods are not "adopted" in the traditional sense of extension programs, but are rather evolved to be appropriate for the local environment and ability of farmers. The concept of "technical adoption" is thus poorly suited to farmers that evolve methods, and especially in the case of IPM which deals with problems on a field-by-field basis (van den Bosch *et al.* 1982).

However, to provide a conceptual framework of IPM practices, the basics of IPM management have been organized into the following four general management principles. These principles provide a basic outline for IPM training courses as well when combined with the training methods mentioned above.

(1) Grow a healthy crop
(2) Conserve natural enemies
(3) *Observe fields regularly*
(4) Farmer's become experts

These principles are intended to move IPM discussions away from "the best mix", or "use pesticide only when necessary" approaches to IPM training. They do not support a component (mechanical, cultural, biological, and chemical) training approach either. Instead, the principles are intended to provide management guidelines to farmers and facilitators. Farmers are field managers, and their decisions are the central focus of training. The technical aspects are subsumed into these higher level management principles

For example, "Observe crops regularly" requires skills and concepts for water and soil observations, plant development, and the potential for crop losses due to pests. It requires that the observer (i.e. farmer manager) make decisions at the crop level (main economic level) rather than at the specific pest level. The importance of this difference is illustrated by the case of leaffolders; early season and late season leaffolders populations rarely cause yield loss due to plant compensation, but mid-season they can cause poor panicle development. The role of water and soil conditions must be factored into these statements when in the field making a field management decision (De Datta, 1981).

Thus the skills and conceptual information behind these IPM principles are supported during training by specific learning objectives in order to carry out the management principles. The areas typically covered within our IPM training programs for extension staff and farmers include the following.

(1) agronomic methods for a healthy and profitable crop
(2) varietal impact on pest management
(3) plant development
(4) pest insect, disease, weed, and rat biology and damage impact
(5) natural enemies of insects and diseases
(6) field observation skills
(7) pesticide health and handling issues
(8) economic management skills

In a field-based training course, all these topics are covered with hands-on field tests in ways discussed above on participatory training. Farmers are asked to carry-out some season-long experiments on topics such as plant compensation or fertilization. Training methods are designed to reveal the underlying ecological processes and provide a conceptual framework for the "whys and hows" of field dynamics. They also carry out short topic specific studies on the IPM related topics and within the framework of the four IPM Principles (Gallagher 1990, Southwood 1978) In example of a short topic is placement of different spider species in small vials together with specific prey items and recording the number of prey attacked. The specific concept is predation, and the specific skill is recognition of spider types.

These courses have been successful in allowing farmers to learn more about their ecosystem and to use less inputs than neighbors while maintaining yield levels. However, the ICP is testing new areas as the above topics alone are not sufficient for future training or for sustainable agricultural practices to be developed.

NEW TRAINING FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT BY FARMERS

In order to push IPM training ahead towards supporting sustainable agricultural, it has been necessary to include more ecological knowledge and a wider range of management skills than traditionally presented in IPM training programs. Several new concepts have been introduced to improve the basic IPM training course for farmers and extension staff in the country programs across Asia. The main six course training improvements are listed in summary form below.

1. Manage the Rice Field Based on the Agroecosystem's Present Situation

a. Determine in the field the current potential yield loss given known plant compensation, fertilizer effect, and plant development/stage interaction.

b. Determine in the field the likely changes in potential yield loss in the coming week given what is known about the disease epidemiology, pest and natural enemy population dynamics - forecasting based on ecosystem factors, plant compensation ability, and agronomic factors.

c. Given the potential yield loss situation, what is the most economic management decision? Many management levels should be considered such as removing water, adding water, adding fertilizer, weeding, spraying, and continuing observation, continuing observation without sprays, or changing the variety in the next season. In some cases management may involve organizing community action for such problems as irrigation system improvements or rat control campaigns

2. Do not Use the Economic Threshold Level as a Literal Numerical Device

The Economic Threshold Level (ETL) and other measures like it, have misled IPM managers and policy makers for many years. The basic concept of the ETL is sound, compare potential yield losses due to pest densities against the potential cost of management. Unfortunately, the ETL is computed based on fixed numbers and is usually given as a literal numeric device; "if the number of brown planthoppers is greater than one per tiller, then spray". This literal approach does not take into account the dynamic nature of the factors involved in the ETL concept thereby basically destroying an essentially dynamic concept by introducing a static number The three main factors of the ETL equation include (1) cost of management, (2) commodity price at harvest time, and (3) a damage coefficient. All three factors are extremely variable for each farmer, crop development stage, locality in relation to markets, soil fertility situation, weather conditions, etc. The ETL concept can be taught and used by farmers because it is good common sense, but the use of ETLs as static numbers to be used in field decision making is misleading.

3. Natural Enemy Populations Depend on Non-pest Prey

The work of Dr. W. Settle in Indonesia has greatly improved our basic understanding of how natural enemy populations can build up in rice fields, even when pest insects are at low populations. Detritivores, which have been largely ignored in most "ecological studies", are likely to be the primary energy intake for natural enemies. This is extremely important in the case of Korea, where natural enemy populations may increase population densities to a sufficient level by late June to consume immigrating brown planthoppers and reduce the possibility for outbreaks. Currently the Agricultural Science Technology Institute is studying this aspect of the rice ecosystem.

4. Disease Management Depends on Probability and Density Factors

Many persons wrongly state that IPM focuses on insect pests. In fact the proper choice of variety, fertilizer inputs, and planting are considered the basis of IPM for diseases. Beyond these cultural methods, observation of the plant and knowledge of weather factors important for epidemics can improve decision making. For example, it is well known that leaf blast up to about 10% does not result in significant yield loss, and that epidemics are most likely on susceptible varieties with high N fertilizer treatments during periods of moderate temperatures (25~30°C) and high humidity. Field factors can be compared with the optimal situation to make predictions on the likelihood of disease problems developing and for making proper decisions regarding field management.

5. Weed Management Focuses on Long-term Targeted Planning

Current thinking of weed management focuses on herbicides to remove or stop germination of weeds. In IPM methods, weed seed and rhizome populations are the key target of field management. Reducing seed densities with late season weeding, and herbicides, or reducing rhizomes with tillage methods are both important strategies depending of the major plant types in the fields. Longer-term IPM strategies focus on dominant species over several seasons to reduce their presence in the field at all stages.

6. Not All Plant Injury Results in Yield Loss

Plant compensation is an important concept which has been heavily studied in wheat, barley, cotton, and soybeans. The concept has been recently applied to rice in the Indonesian Rice IPM Program with leaf and tiller cutting experiments which show that the rice crop can sustain significant injury without yield loss. In Korea this is important because most farmers apply pesticides in mid- to late-June to control stemborers, although it is now shown that typical stemborer populations do not cause yield loss. The pesticide applications are made just before brown planthopper immigration, and may be reducing natural enemies at the key moment when brown planthopper outbreaks depend on initial mortality (Gallagher *et al.* 1994).

7. All Pesticides Have an Environmental Impact Which Is an Economic Impact

While it is common knowledge that pesticides kill fish, natural enemies and other non-target organisms, the economic impact of this environmental damage has not been properly presented. Protection of the environment for the sake of the environment itself is certainly well accepted, but the economic impact strengthens calls for protection. Easily computed impact in Korea includes the increased cost of cleaning water for urban consumption, and loss of fishing income from sport fishing in waterways. Less easily computed losses are those related to health, coastal fisheries, and loss of biodiversity

NEW DIRECTIONS IN POLICY

IPM policy is changing rapidly. Basic biological and social facts lead to some of the following policy directions:

(1) Each field is unique due to past and present management, micro-climate, and variety. Mass action, aerial sprays, forecasting systems, and broadcasting control recommendations should not be carried out without complete field observation.

(2) All pesticides are polluting and have a social cost (water resources, biodiversity, health impact) and therefore should be heavily taxed based on the "polluter pays" principle.

(3) Pesticide supports slow development of alternatives such as biological control agent commercial production, pheromones, and resistant varieties Subsidies, tariff reductions, government supported sales, and other benefits should be provided to alternatives and not to pesticide companies.

(4) Pesticides are dangerous to the user and to society. Users of pesticides should have licences to purchase, and apply compounds allowing assurance that farmers have complete knowledge of pesticide use and application methods (van den Bosch 1989).

(5) Future food security depends in a large part on farmer management skills to produce crops without destroying the underlying resource base. Therefore, social investment in practical farmer trainings is essential to insure food supplies and environmental quality (Devall 1988).

FUTURE DEVELOPMENTS

The FAO Inter-Country Program is committed to farmers becoming better partners in research and in community development of sustainable agriculture. Future development in the training program include farmer-led research, training-driven research prioritisation, farmer-to-farmer community level programs to assess and solve local agricultural problems, and improved competitiveness for rice farmers in the world market in the face of the recent UR/GATT agreements. The future of a secure food supply system and reduced environmental impact lies in the hands of farmers and rural communities. They deserve and need complete training-not simple messages-to build a new sustainable future.

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