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ADOPTION OF THE INTEGRATED PEST MANAGEMENT (IPM) APPROACH IN CROP PROTECTION: A RESEARCHER'S VIEW[1]

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ABSTRACT

The extent of adoption of the IPM approach in crop protection has been less than desired and differs with crop, being higher on rice than on vegetables with damage-free market requirement. The perceived constraints to adoption are (1) unacceptability to many farmers of the recommended pest population monitoring procedure (counting insects on sample plants) to assess the need for control tactics application, (2) limited availability of the recommended biological control agents, and (3) inadequacy of IPM programs for the farmers' numerous pest problems. The last constraint is a consequence of the slow turnover of ready-to-use control tactics, or failure to integrate and adapt them to different conditions.

The farmers' great dependence on pesticide use in crop protection is expected to continue unless equally acceptable alternatives become available to them. To facilitate IPM program development, it is suggested that the system for research and development program planning be improved (should be more problem-focused), arrangement for control tactics integration be institutionalized, and effective feedback sytem on field performance of the recommended crop protection technologies be established.

Key words: Integrated pest management, crop protection, constraints, adaptation, dissemination.

INTRODUCTION

Man's combat with pests must have started with his pursuit of crop production to meet his needs on a continuing basis. Until early 1970's, the strategy widely promoted and adopted in the Philippines for limiting the damage on crops was pest control, or reduction of the pest population to the lowest level possible. The strategy proved convincingly effective and economically advantageous when pesticides became readily available for farmer's use in protecting his crop. Because of their marvelous effectiveness, very fast action, ease in procurement, and simplicity in use, man must have thought that his battle with pests was over. Additionally, the mentioned attributes of chemical pest control must have become the standard or main qualities that a farmer looks for in any crop protection tactic offered for his use. And with the threat from pests effectively diffused by pesticide application, the developmental pursuit for other control tactics was reduced to the minimum for quite a time, if not abandoned totally.

But the happy days of pesticide use did not last forever. With prolonged, extensive, and sometimes injudicious application of the poisonous materials on the crops being protected, some pests developed resistance and could no longer be controlled, pest resurgence became frequent occurrences, and public concern for environmental safety developed into a major issue. All these convinced the national planners, researchers and administrators alike that a change in strategy from pest control to pest management, or IPM, was urgently needed. From all indications, however, it appears that as a whole, the actual practice of IPM by crop growers following the researcher-recommended system has been less than what the proponents have hoped to achieve. This paper highlights the probable constraints to wider adoption of the IPM approach to crop protection particularly against arthropod pests (insects and mites) as perceived by a researcher of an academic institution. It also offers some suggestions aimed at improving the situation.

Definition, Objectives and Adoption of IPM

Before going further, it may be necessary to clarify the meaning of some terms used in this paper and review very briefly the objectives and approaches used, to avoid miscommunication. The term IPM has been used to mean either integrated pest management or insect pest management. Many entomologists, including the author, would like to propose the adoption of the latter meaning, while researchers in other fields seem more accustomed with the former. Many researchers believe that it would be better to drop the word integrated to avoid the misconception that it is absolutely necessary to use at least two (2) control tactics to manage pests effectively. This maybe one reason why a number of people have expressed doubts as to whether IPM programs already exist. Apparently, they are viewing IPM only at the highest level of control tactics integration aimed at managing pests belonging to two or more groups (arthropods, plant pathogens, vertebrates and weeds) which affect a crop simultaneously, or in succession. Obviously this would need more than one tactic. Overlooked probably are the other two levels of integration. The middle level targets two or more pest species belonging to only one group, while the third and lowest level targets the management of only one species, but making sure that the co-existing other pests do not get favored by the adoption of the tactics integrated. In this paper, the focus of discussion is the lowest integration level (targeting only one pest species).

Rabb (1972) defined pest management as "....the intelligent selection and use of pest control actions (tactics) that will ensure favorable economic, ecological and sociological consequences". It is not a package consisting of a fixed number or kinds of control tactics but a system, an approach or a strategy for protecting crops against pest damage. It neither bans the use of petroleum-based pesticides, nor requires inclusion of all the control tactics available. However, actual experience has shown that satisfactory management of most pests often requires the use of more than one tactic with chemical control as one of them. This multi-tactic requirement gave rise to the term integrated pest management or IPM for short.

In adopting the IPM approach to crop protection, a crop producer is supposed to decide the combination of tactics which he thinks would be most advantageous to use under his particular situation. The combination of control tactics that he adopts is location and pest problem specific. The alternatives are given in the IPM programs or listings of available control tactic alternatives to select from, with instructions on how to integrate them. Envisioned to guide a farmer in his choice of control tactics are the extension workers or field technicians of the Department of Agriculture (DA) assigned in the area.

In developing the IPM programs, the researchers have been guided by the following objectives: (1) ensure safety of the product consumer; (2) minimize occupational hazard to farmers from pesticide handling; (3) minimize the contribution of pesticide application to environmental pollution and the adverse effects on the non-target life forms; and (4) reduce crop protection cost without necessarily reducing productivity, thereby enhancing the profitability of the production venture. In accomplishing the objectives, three approaches are being followed, namely, (1) promotion of judicious use of pesticides (application based on need); (2) use of relatively safer pesticides whether oil-based, botanical or microbial; and (3) greater use of non-chemical control tactics. The first approach calls for observance of the established need indicator (technically called economic threshold level or ETL) for each targeted pest; the second necessitates identification of locally abundant plants with pesticidal value and development of farm-level techniques for their preparation into ready-to-use pesticidal materials; and the third entails the use of existing cultural management practices which can contribute to suppression of pest population build-up, and development of other non-pesticidal but effective control tactics.

Perceived Constraints to Wider Adoption of the IPM Approach to Crop Protection

It was mentioned earlier that, as a whole, the rate of adoption by crop growers of the researcher-recommended IPM approach appears to be much less than what the proponents have hoped to achieve. It should be clarified though that much variations exist among crops and pest species targeted. If the practice of calendared pesticide application (as recommended and widely adopted before) is used as the starting point, it can be said that substantial progress in the adoption of the IPM approach has been achieved on rice, but only minimal, if any, on vegetables.

During the scientific meeting of the Pest Management Council of the Philippines (PMPC) held in Cebu City on May 4-7, 1993, it was learned that at present most rice farmers apply pesticides only twice (rarely thrice) during the entire cropping season in contrast to 4-6 times under the Masagana 99 rice production program implemented by the government several years ago. At present, some rice farmers forego insecticide application totally, while others monitor pest abundance and apply only when necessary. In contrast, not few farmers invovled in commercial production of cabbage, pechay, okra, eggplant, beans and tomato start applying insecticides as soon as insect infestation is observed without determining the level of infestation.Application is repeated every 2-7 days depending on the rate of pest population build-up, and as late as a day or two before harvest. Some vegetable farmers even mix two or more insecticides, or they double the concentration applied if infestation persists. Certainly, such practices are not in accordance with the IPM approach to crop protection.

One constraint to adoption of the IPM approach appears to be the unacceptable pest population monitoring procedure. It is said that big and small crop growers may differ in the choice of the system that they adopt and in the magnitude of operation that they undertake, but they are similar in their desire to maximize the benefits from their production resources. Therefore, the mentioned practices of many vegetable farmers which result in higher production cost must have been viewed by the producers concerned as still more advantageous to them than the recommended IPM approach. At present, the IPM approach for most insect pests is essentially the observance of the economic threshold level (ETL), which is also called control action threshold (CAT). Some of the established ETLs are (a) 2 diamondback moth worms per cabbage plant at early vegetative stage and 5 at pre-heading stage; (b) 2 fruitworms per tomato plant; (c) 2.5 leaffolder worms per bean plant; and (d) 2.7 pod borers per 20 bean plants.

Most farmers find the recommended procedure for infestation monitoring (counting the insects) too time-consuming and laborious. They have claimed that pest monitoring is not worth the effort and time they spend. This is probably because the greater benefit from reduced pesticide application (which is minimized health hazard for both crop producers and product consumers) is not quantifiable and will not go to the farmers as cash profit.

Rejesus (1991) said that quick visual assessment, like counting the cabbage plants with holes, will be more acceptable to farmers than counting the worms present in the sample plants. However, accurate pest identification is essential and very similar holes can be inflicted by 2 or more kinds of worms, hence the greater preference of researchers for insect counting. Adalla (1990) also said that the importance of judicious pesticide use to reduce production cost and conserve the non-target beneficial organisms is already appreciated by many farmers, but a big challenge remains: the development of a monitoring scheme that farmers will feel comfortable to use.

Another constraint is the limited availability of the recommended non-pesticidal control tactics like biological control agents. As stated in Appendix A, the recommended parasitoids for the diamondback moth are being supplied initially by two academic institutions. Understandbly, the two sources will not be able to supply interested cabbage farmers with all the parasitoids that they may need. Therefore, some growers who may want to adopt the IPM approach for the diamondback moth may not be able to do so.

But the biggest constraint probably, is the lack or inadequacy of IPM recommendations for the different pest problems that crop growers complain about. Among the so many important crop pests, the diamonback moth attacking cabbage and the corn borer are the only two with biological control agents already under mass production. Therefore, the farmers are constrained to depend solely on pesticide use for protecting their crops from the other pests. As mentioned by Bernardo and Eusebio (1993), the pest problems that many farmers complain about are not new, the amount of money already spent in developing technologies directed against them is not meager, the researchers who have participated in technology development are not few, but the turn-over of ready-to-use and widely accepted pest management techniques has been rather slow. The author believes that no one individual or office should be blamed for this constraint because it appears to be largely an inevitable consequence of the existing national organizational structure for research and extention.

Pest Management Technology Development, Adaptation and Dissemination in the Philippines

Andrade Alves (1984) said that "…. development of a technology is a continuum which begins with identification of a problem of a farmer and ends when he adopts at least a part of the technology developed." The process can be represented by the following diagram:

Problem identification ----> Tech. dev., testing, adaptation ------> Tech. integration adaptation --------> Tech. dissemi-nation and farmer adoption

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Research ----------------> Area of inter face -------> Extension

Interpreting the diagram, Bernardo and Sumalde (1988) pointed out that the activities at the left end of the continuum clearly belong to researchers and those at the other end, to extension workers. The activities toward the extension, or area of interface, are the ones causing confusion and are often neglected. It is at this region that the integration of research and extension takes place. If not attended to, the technology development process will not be completed, the scientists' effort practically wasted, and the target clientele (farmers) not benefited.

But a different problem is often met also at the start of the research phase. As can be discerned from Appendix B, development of a pest management tactic is not an easy, simple task. This is because any projection that a particular intervention will work under actual field conditions must be backed up by adequate and reliable basic information generated by supportive studies Most of these studies are undertaken by thesis students, research staff and faculty members of academic institutions as independent investigations which are conceived separately and not as components of a well-planned research program designed to target a particular pest problem. One can understand, therefore, the difficulty faced by a researcher in collating the existing widely scattered information if he decides to pursue the development of a pest control tactic. Under the present set-up, it is highly possible that a badly needed supportive research may not be undertaken casually by anyone, while others might have been pursued more than once. It is sad to admit that the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) which is the national coordinating agency does not always get a copy of a research report for record and monitoring purposes.

To illustrate the full developmental process, the IPM technology for corn borer (Appendix B) will be used. It was put together by a university professor with funding from PCARRD. She made use of the relevant basic information generated by various researchers and the component technologies developed by herself and by other scientists. The formulated tactics combination was field-tested in Cagayan, Laguna, Bicol region and Cotabato under the scientist's supervision, but involving researchers of the DA and other academic institutions. From thereon, any additional adaptation testing and eventual dissemination to farmers was the responsibility of DA. But the researcher who put together the various tactics never got any feedback on the IPM recommendation related to (1) its performance. (2) needed modification to suit specific local conditions, and (3) extent of dissemination or adoption. The establishment of a few mass production centers for the egg parasitoid in some parts of the coountry implies that this biocontrol agent is being used in the field. However, there seems to be no one using the recommended predator for undertermined reason.

Analyzing the situation, it seems that important shortcomings exist in the national organizational set-up covering research and extension. Most of the research centers/institutes are university-based to take advantage of well-trained academic staff and research facilities. These institutions generate a lot of useful information and develop different kinds of technologies, yet, their extension function is limited to training of extension workers and farmer leaders, and preparation of technoguides and other information materials. But the actual delivery of extension services, including technology dissemination, is a mandate for DA. Because of this set-up, there must have been many technologies developed in various fields that do not get verified or adapted to many test locations. The reasons for this could be: (1) the extension workers did not learn about the new technologies, (2) when further tested, some adjustments were found necessary which were beyond the extension worker's expertise, or (3) the technologies were not directly relevant to field problems. Feeling frustrated, the researcher may conclude that the extension worker is not doing his job, and the latter may blame the former for technology irrelevance.

The problem mentioned is more serious in the case of crop protection technologies. In addition to unclear agency assignment on technology adaptation to field conditions, there seems to be an unclear arrangement also for control tactics integration to come up with suitable combinations. With several crop protection researchers in different government agencies working simultaneously on control tactics development, some of their outputs are probably lying around and awaiting integration. Ideally, this should be done jointly by the researchers who developed the technologies and the extension workers who will disseminate the IPM program to the crop growers later on. But somebody should initiate the action and continuously provide the necessary coordination leadership until work completion.

The above presentation of constraints to wider adoption of the IPM approach to crop protection related to national organizational set-up should not be interpreted as an insinuation of the need for a drastic revamp of the sytem. There must be advantages of the present set-up as well. Thus, the shortcomings may be considered as part of the trade-off. What is insinuated here is the need for a decisive action to facilitate IPM program development inspite of the constraining set-up.

A Word on the Role of Insecticides in Crop Protection

The unwillingness of many farmers to adopt the currently recommended insect pest monitoring procedure, and the inadequacy of the available IPM programs for meeting the farmer's needs, suggest that insecticides are likely to remain in the front line of defense against insect pest attack in many more years to come. Another contributory factor to the continuing dependence on chemical control is the market-imposed high-quality requirement (damage-free) for farm products like fruits and vegetables. At present, it appears that under large scale vegetable production, only insecticides can do the job of providing the level of protection that the farmers want against most arthropod pests, without help from other control tactics. There are situations also which need fast control action, as when a maturing rice crop is attacked by panicle-cutting worms that can destroy large areas overnight. At present, only insecticides can provide the urgently needed immediate rescue under such a situation.

But the reported chemical control practices of many vegetable farmers are very disturbing indeed. Thus, all effort should be exerted to find in the shortest time possible, some ways and means of lessening the need for very frequent pesticide application by slowing down pest population build-up. The three possibilities are (1) use of pesticides least adverse to natural enemies, (2) development of pesticide-resistant natural enemies; and (3) development of pest monitoring techniques acceptable to farmers to encourage application of pesticides based on actual need. Studies along these lines should be given full support.

RECOMMENDATIONS

1. Improve R & D program planning for IPM. During the 1993 PMCP annual scientific meeting mentioned earlier, an AD HOC Interagency Working Group was formed to identify the most important and pressing crop protection problems that should be accorded priority attention in technology development. The Group confined the prioritization to crops with no existing research centers, and recommended to PCARRD the holding of small-group workshops to (a) identify the most logical and practical control tactics against each target pest, (2) line-up the specific studies to be undertaken if the identified tactics are still to be developed, and (c) pinpoint the researchers most qualified and ready to undertake the studies. It is hereby suggested that the commodity-based research centers do the same for the crops assigned to them.
2. Institutionalize an arrangement for facilitating adequate field testing and integration of the control tactics developed by different scientists. It should

allow participation of interested scientists who developed the component technologies so that the needed modifications can be introduced readily and with minimum difficulty. At the same time, DA field workers who will disseminate the technologies and help farmers adopt them should be involved also to avail of the chance to develop the needed expertise in technology refinement to suit varying field conditions.

3. Improve the feedback system on IPM technologies being tried by farmers so that the researchers who developed them would know the modications that should be introduced. This is urgently needed for the currently recommended "need indicators" for control tactics application.
4. For more immediate use, identify the pesticides "more friendly" to the non-target life forms, and develop populations of natural enemies more resistant to pesticides.

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Appendix A

NAME OF TECHNOLOGY: Management of Diamondback Moth (DBM) Using Parasitoids With Supplemental Application of Microbial Or Selective Insecticides

DESCRIPTION OF THE TECHNOLOGY:

This technology involves an Integrated Pest Management (IPM) approach to the control of Diamondback Moth (DBM), *Plutella xylostella* L. on cabbage. The control is from the seedling stage to harvest time using parasitoids such as *Trichogrammatoidea bactrae* Nagaraja (egg parasite), *Cotesia plutellae* Kurdj and *Diadegma semiclausum* Horstm. (larval parasitoid) with suplemental application of microbial (B.t.) or selective insecticides (Brimor and IGRs). In addition, covering the seedlings (in seedbed) with nylon net, spot spraying and sanitation are recommended also.)

APPLICATION:

1. Mass-produced parasitoids (*Cotesia* and *Trichogrammatoidea* are initially supplied by the Department of Entomology, UPLB and *Diadegma* by the Benguet State University, Benguet).

2. Sow and plant cabbage continuously if possible and practice clean cultivation, and sanitation.

3. Field release parasitoids two to three weeks after planting: *C. plutella* and *D. semiclausum* = 5,000 to 10,000 cocoons/ha; T. bactrae = 60,000-80,000 parasitoids/ha.

4. Monitor DBM population for CAT (Control Action Threshold) to determine the need for supplemental use of microbial/selective insecticides (3rd/4th instar larvae more than 2 per plant at early stage, or more than 5 at pre-heading stage, spray the plant with microbial or selective insecticides).

5. Determine parasitism. If combined parasitism is below 75%, additional release of parasitoids is needed.

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Appendix B

IPM program developed by UPLB scientists* for the Asian corn borer. (after Bernardo and Sumalde, 1988)

Pest Management Tactic	Projected Contribution	Areas of Supportive Research Used as Bases
A. Foundation Tactics		
1. Field sanitation	Reduction of initial sources of infestation	Pest biology, ecology, host range
2. Resistant corn variety	Reduced attraction to borer, reduced rate of borer population build-up, greater host capability to withstand borer damage (depending on resistance mechanism present in the variety)	Varietal screening for pest resistance, crop breeding to incorporate resistance in a commercial crop variety, pest biology, ecology, physiology and behavior.
3. Early planting date	Evasion of peak of borer abundance	Corn borer seasonal abundance, crop ecology or enviromental requirements.
B. Additional Tactics** (when economic threshold level of infestation is reached)		
1. Release of egg parasitoid	Increased pest mortality	Search of prospective parasites, parasite efficiency, biology, host range, host finding, ecology, behavior; susceptibility of different

		stages of borer to the parasite, specificity; parasite mass-rearing and releasing techniques.
2. Application of petroleum-based insecticide	Increased pest mortality	Pesticide efficacy against the borer and side effects on other organisms; residual toxicity under local conditions.
3. Application of microbial insecticide	Increased pest mortality	Microbial identity, efficacy against pest and other organisms including man; mass production, formulation and packaging techniques.
4. Inundative release of predator	Increased pest mortality	Predator identity, biology, ecology, efficacy against the borer and other organisms, mass production and field release techniques.
5. Detaselling	Borer population reduction through removal of some infested tassels and limitation of favorable sites for borer development.	Borer biology and ecology in relation to parts and growth stage of corn plant.

* led by Dr. B.M. Rejesus, Professor, Dept. of Entomology, College of Agriculture, UP Los Baños.

** Any one of tactics numbered 1 to 4 plus number 5.