

ENVIRONMENTAL EDUCATION: A KEY FACTOR IN URBAN PEST CONTROL PROGRAMS

CARLOS FERNANDO S. ANDRADE

Department of Animal Biology, Institute of Biology,
State University of Campinas – UNICAMP, Campinas, SP, Brazil

Abstract Education has been enrolled as a component of Integrated Pest Management (IPM) programs, but in fact it should be more than that. Urban pests are so intrinsically related to human life and habits that we can always find where, when and how people (or costumers) can act helping to change urban pest presence, density or damage / impact. This paper aims at discussing some examples to highlight that environmental education may be the key factor, leaving less weight to the other components of the IPM. An analysis was made based on some manuscripts from the last six Proceedings of the International Conference on Insect Pests in the Urban Environment, and some personal experiences. From pests such as head lice to black flies, or from the vector of dengue to bats, rats or mites, what can be indicated is the need for more research on education, for a better control success in the future.

Key Words Training, students

INTRODUCTION

The great aim of education is not knowledge but action. This citation from the Victorian biologist and philosopher Herbert Spencer (1820-1903) will help a clear introduction, and the fragment “education is action” will be reminded sometimes.

Pest control has always been a human activity long before the outcome of applied entomology as a science dealing with environmental intervention techniques. From Neolithic times until the industrial revolution, man has empirically used simple strategies, sometimes copying the lessons from natural control. But with the discovery and growing use of synthetic chemical insecticides, the already used massive production and release of natural enemies, mainly insects, obviously have to be rethought. With the following advent of industrially produced biological insecticides, integrated control came as a concept in order to propose a harmonic blending of these two tools in pest control. In this historical sequence, the most important conceptual advance on pest control came with the adoption of the term Integrated Pest Management (IPM) – adding ecological and socio cultural aspects, such as education and community participation (Wood, 1988; Kramer, 2004). It was about time! But, ahead, there was still moving from theory to practice, since education is action.

According to Luckmann and Metcalf (1982), there are many definitions for IPM and one of the earliest one was provided by Rabb (1972), as the intelligent selection and use of pest-control actions (tactics) that would ensure favorable economic, ecological, and sociological consequences. The above mentioned book was devoted mainly to agricultural pests and crop protection, but new general concepts were clearly launched at that time. As Luckmann wrote on the last chapter (Chapter XVI, Pest Management and The Future) of this co-authored book, just short of a decade had passed since the book was first published in 1975. And they hoped that the presented principles, concepts, and methodologies should widely promote IPM advances and successes. Indeed, it was just a few years later that Axtell (1979, 1981) adopted the term IPM and the IPM principles for mosquito and livestock pest control programs. Some years later, a book from Laird and Miles in two volumes (1983, 1985) and a book from Youdeowei and Service (1983) were important for consolidating the broader concepts of pest management rather than control. Unfortunately, these treaties did not address sufficiently specific and direct aspects to the urban pests, and neither about education as an important tool in management. But in fact, anyone can find in almost all of the chapters of those above mentioned books strong indications of education as a key factor. And not surprisingly, education is being taken both, as a strategy as well as a principle or a work philosophy. But education is hidden in subtitles like “socio-economic considerations”, “acceptance of new concepts”, “people’s attitudes”, “training programs and training needs”, “public enlightenment”, “community level cultural practices”, or simply as “information”.

My professional experience as scientist and professor of biology at Unicamp led me during the last 25 years to teach Biological Control, Pest Management and Environmental Education. My master's degree in Ecology was about the integrated control and the use of nuclear polyhedrosis virus against the cotton American Leaf Worm *Alabama argillacea* (in 1981). Our researches at that time were based on ecology of natural enemies, chemical and biological insecticides, insect growth regulators, pheromones and traps, monitoring systems and so on. However, no education such as strategy or philosophy was included at that time. But education became crucial in 1983, when, with a good help from the media, together with some colleagues from the University of Campinas, we could elucidate, convince and mobilize farmers, community leaders and politicians. The final act was some lawsuits against the Ministry of Agriculture to prevent the insane aerial applications of toxic insecticides in order to eradicate (sic) the cotton boll weevil, detected in our country that year. Such a history is promised to be written by the colleague M.E.M. Habib, my mentor at that time, as soon as he retires in a near future.

The present paper aims at discussing the future. And also to discuss education as a key factor, meaning also a philosophy and the axis for most urban pest management programs, in order to promote actions. Some considerations on the involvement of education in control attempts in the past will help to address the subject as well as some personal experiences of mine.

MATERIALS AND METHODS

Far from trying to do a meta-analysis, just a simple search was done on the International Conference on Urban Pests (ICUP) web site archives for a discussion. The search at the site can be done by categories, and allows access both to the "Abstracts" or the "Full Paper" presented or to the "Poster Abstracts". Initially a search for the term education was done, considering the category "Abstracts". Then another search was carried out for the same term for all categories (titles, authors, key words, and abstracts). The full references are not provided here once the texts can be easily accessed on the ICUP web site (<http://www.icup.org.uk/icupsearch.asp>). To address my perception that education, in fact, could and should be more considered and enrolled on IPM practices, a study on the text of some full papers not found by the search engine will help the discussion.

RESULTS AND DISCUSSION

Using the search engine on the IUCP website for the Proceedings of the 1st and the 2nd International Conference on Insect Pest in the Urban Environment, we can find strong indications that education could and should be more and better considered. For the two conferences, only one full paper was found for the term of search "education" as key word. If the same term of search is used for all categories, two full papers and one poster presentation can be found. The paper found with "education" common for both the searches was presented in the Conference at Cambridge, 1993, by Alan C. York (Title: "An Educational Assist to Urban Pest Management"). The other two were, respectively, on tutorials for training program for pest control operators (PCO) or interested individuals (presented by Fasulo and Koehler, at Edinburgh, 1996) and on health education aspects for cockroach control, by Christine Brown (at Cambridge, 1993). The educative approach of the three presentations is obvious and I would like to congratulate and to transcribe some phrases by the Purdue University professor Alan York on his introduction, i.e., "I've concluded from my 25 years of research, extension, and teaching activities that a different approach must be made in dealing with those one wishes would implement pest management. ... (IPM) is a philosophy and not a technology. It is acceptance of a belief, a set of principles, a set of guidelines by means of which one then implement certain technological applications" and "...we must implement new educational approaches if IPM is to be adopted significantly in the urban and rural communities. Consumer attitudes must be changed". Professor York clearly indicated a need for researches and education as action.

By reading some manuscripts presented in both the first and the second ICUP that were not found in the above search, we can find clear mentions on aspects of education. Such finds may indicate that education really matters, but unfortunately it has been poorly or miss considered, and even transversally and badly approached.

Sbragia (from the company DowElanco) presented the article "Current Issues in Urban Entomology: Resistance, Legislation, and Public Perceptions" (ICUP at Cambridge, 1993) and it was literally pointed that "...as an industry, (we) need to do a lot of things better – specifically: 1- Focus on the needs of the costumer. ...Believe me; giving them what they want will be far easier than changing their opinion". In fact, it may be easier to follow Sbragia advice. But if education is to be the axis, an industry (and by extension the PCOs) should investigate and deal with the costumer opinions and consumer sentiments, which are based on their knowledge and understanding of the problem. The slogan "what you want is what you get" may not be always good, safe, environmentally acceptable or even efficient when we are managing urban pests, even if sometimes possible or affordable.

A good example for this subject may be, I think, some programs on the nuisance black fly (*Simuliidae*) population control. From the southeastern coastal areas of Brazil to Argentina, *Simulium pertinax* used to be the worst biting fly and nuisance pest, imposing some health problems to humans and economic loss to tourism and family agriculture. Highly temephos resistant populations and the high cost bacterial products based on *Bacillus thuringiensis israelensis* importation from USA made most programs very difficult and critical in the 1980s (Andrade, 1987; Andrade and Castello Branco, 1990). For some years we have investigated in the municipality of Ilhabela (State of São Paulo, Brazil) how many bites people could tolerate a day – as an approach to the IPM concept of Economic Injury Threshold and Economic Injury Level (also known as Aesthetic Injury Level (AIL) - The level of pest abundance above which aesthetic or sociological considerations suggest control measures should be taken against the pest (See <http://www.blackwellpublishing.com/Towns>). In short, we had some obvious results. Low-income and poorly educated resident people said they could tolerate as much as they were being bitten, but they wish less bites. Regular tourists for the summer season, occasional visitors and high-income residents said they couldn't tolerate it anymore, and they wished zero bites. And, not amazingly, after some explanations about blackfly biology, the shortage of available techniques and products, and how difficult for a state control program deal with larviciding treatments for each 15 days, all the year long, applied to almost all the streams near the urban areas (actually, a lot of streams), some change was found in the opinions. The people from the first group changed their view indicating they wish now less bites and the people for the second group changed for anything other than zero bites. So, education can at least quantitatively change the client's wishes.

Another example shows that the impossible may be possible occasionally. Many years ago a PCO company owner confidentially told me during a meeting in Posadas, Argentina, that the president of the republic that time, Carlos Menen, eventually used to enjoy two days in a beautiful ranch on the edge of the La Plata River. The owner of the ranch, his client, obviously demanded zero bites of black flies during those days. The solution, for two days only, was a huge spray bath of piretroids on the ranch's buildings and facilities.

Searching through the hard copy of the Proceedings of the 1st and the 2nd International Conference on Insect Pest in the Urban Environment (Willey and Robinson, 1993; Willey, 1996) it can be found education (or lack of education instead) involved in many manuscripts, but not mentioned or literally considered as important to be treated. C.F. Curtis (Manuscript title: "Alternatives to Conventional Insecticides for Urban Vector and Pest Control", ICUP at Cambridge, 1993) regret that "residual house spraying is an unpopular method with residents of houses with painted walls, or who have believed lurid accounts in the media of the supposed dangers of insecticides, or who are dissatisfied with the inability of house spraying to deal with nuisance *Culex* mosquitoes". And, some lines below this citation, Curtis mentions that in Cuba the elimination of *Aedes aegypti* breeding sites in the houses is effective because is rigorously applied. He doesn't comment, but we know that education is a key factor in Cuba, both as a philosophy and as well as action.

J.H. Hainze, from the company S.C. Johnson & Son, Inc., presented his manuscript which title deeply promised to consider "education" as important, i.e., "Consumer Based Strategies for Household Insect Control" (ICUP at Cambridge, 1993). He used more than 7,000 words and made no citation of the words "education" or "instruction" or even "information". Among six points that help clarify the basis for the insect control strategies employed, he pointed out that: "1. Relative to other insect control activities, the end user is an amateur, with little knowledge of the insect or the control device/chemical" and "3. Since the user has little understanding of the product, there is considerable potential for misuse or misapplication. Therefore, the product must be somewhat "foolproof" in its formulation and design to ensure that the consumer will obtain a satisfactory result". In theory, the companies do not even need a brain if they have totally foolproof products. But since a company aims at a "somewhat foolproof" product, why not apply IPM principles, working to change the mentioned "little understanding of the insect or the control device/chemical" to a better degree of understanding?

Head lice IPM may essentially be based on education. Not just as a key factor, but more, as the main factor, or even as the only factor. By means of education (as action), parents should be able to carry out regular surveillance and an efficient head lice control on their children. Parents can do the same about the friends and relatives that live and play with their children, and can help educating other parents to do the same. Although focusing mainly on products, the manuscript from Richard C. Russell ("Requirements and Problems for Control of Some Arthropods Pests of Medical Importance in Urban Australia", ICUP at Cambridge, 1993) pointed out some critical issues for this question. Russell mentioned that "More community education is an imperative, and should be directed towards a better understanding amongst parents that head lice are a community problem, that there is no stigma associated with infestation, and that children and contacts within and outside of the family of the person with an infestation must be treated effectively in order to control the problem within the community". We have to completely agree.

More than ten years ago, sponsored by the company Johnson & Johnson, my research group started searching for good botanical pediculicide formulae. We were contacted that time by a person that for many years produced, sold or gave hundreds of liters of his pediculicide shampoo. It was a botanical formula and a familiar secret, passed from his grandmother and allegedly very efficient. He sent us a sample and instructions. We carried out a double blind assay in parallel with a common Johnson & Johnson shampoo. The treatments for this bioassay were carried out, exposing groups of 30 adults plus 10 nymphs of head lice to the shampoo for one minute, gently rubbing to make foam. The insects were then maintained on the shampoo foam for one hour, according to the instructions, and after this period, they were washed, rinsed and allowed to blood feed. The mean mortality was recorded at the end of the treatment and for one, five, nine, 16 and 24 hours after treatment. No expressive mean mortality could be noted for both the shampoos and reached 22.5% for the botanical formula and 13.5% for the non pediculicide shampoo (unpublished data). Even so, we can attest that the botanical formula should be actually very good, considering what that person said additionally. He explained that he used to insist with his costumers to repeat the treatment every day, for one week, proceeding carefully a combing with the nit comb while the hairs were still wet. Here we find education in action, instead of chemical control. Our group followed searching for new shampoo and lotion formulae, but we create also in 2002 an Internet domain (headlice.org.br, in Portuguese) mainly devoted to education and the use of suffocation and regular nit combing as the main strategy for head lice control (see <http://www.piolho.org.br/>).

Another example can be found on the manuscript "Prevention and Extermination Strategies for House Dust Mites and their Allergens in Home Textiles", presented by Johanna Van Bronswijk (ICUP at Cambridge, 1993). The abstract starts with "Preventing and exterminating clinically relevant concentrations of house dust mite allergen in the urban environment is one of the more interesting challenges for architects and building engineers, pest control contractors, cleaning services, and sanitary biologists, as well as patients and physicians". Reading the manuscript and the concerns addressed, it is very easy to rewrite this starting point by adding "environmental educators" among the professionals enrolled as challenged. Indeed, we can hope that the mentioned "sanitary biologists" could play a part in the education needed in order to manage home environment, to help lower mite infestations. But the author does not indicate this role of sanitary biologists as his proposal.

Cockroach control permits good examples where education was miss-considered and can be discussed. The manuscript "Cockroach Control in the Netherlands" (by J. T. De Jonge, ICUP at Cambridge, 1993) and specifically the final lines of its abstract are obviously enough to indicate this, i.e., "There are some indications that resistance against insecticides is becoming important. However at the moment in most cases cockroach control can be carried out successfully, especially when there has been great care taken in convincing the occupants or organizations concerned that their co-operation is essential". In the discussion, we can also find phrases such as "Only when the co-operation of the inhabitants was poor there were problems with the results of the action" and "The most important reason however why populations of the German cockroach are not completely destroyed is the fact that in a substantial part of the cases co-operation of the inhabitants of houses is refused". It seems clear that the point here is unconvinced occupants and poor or refused co-operation. And it seems also clear so, that despite the indications that resistance of the German cockroach was becoming important, the most important actually was how to educate in order to get the action of co-operation.

Also, from the manuscript "Computer Aided Decision Support System for American Cockroach Management in the Urban Environment" by Nonggang Bao and Robinson (ICUP at Cambridge, 1993) we can highlight the role that an environmental educator may play. The authors pointed out in the introduction that "An urban IPM program must consider more directly the sociological and psychological needs of the target audience, rather than economic measurements that are standardized in agricultural IPM programs. The aesthetic injury level (AIL) concept was proposed to respond to these needs...". And, appropriately, they presented a program for a decision aid system that involves clients' (Individual or Collective) attitudes. The example supplied by Bao and Robinson refers to a hypothetical American cockroach infestation in a large apartment complex, and they explain "Determination of the aesthetic injury level in MACDAS was achieved by asking the user to input the relevant attitudes of the target audience towards an American cockroach infestation and control. Specifically, a group of residents were surveyed by the decision maker, the property manager, or pest control specialist". My question is that this final step could better be "Specifically, most (or almost all) of the residents were surveyed..." considering that cockroach in any apartment complex is a collective problem. The AIL therefore, may be fixed by everybody, or a huge majority of the residents.

Recently, I had a good example for the difference we can find among the enrollment of a group of residents versus almost all residents, when dealing with a collective urban pest. My wife and I, together, carried out a simple

educational approach among seven neighbors living in a small rural community in order to convince them to repair the covers of the septic tanks in their houses, thereby inducing other neighbors to do the same, to help eliminate the source of the nuisance mosquito *Culex quinquefasciatus* infestation in the neighborhood (Andrade and Nascimento, 2010). We expected (not too much, really in fact) that the high lowering of nocturnal biting attacks from the mosquitoes that we experienced for the following weeks on that place should be enough to spread this action for the rest of the community, but it did not. Six months after, a student attending to my summer course of Environmental Education carried out the same project and showed us how to succeed. During one week he visited all the 100 properties (dwellings, local shops and other buildings such as churches and the school) at the same community. He also teaches aspects of the bio-ecology of the house mosquito to about 60 children from first to fifth grade at the only local school. As a result, 10 of the owners took immediate corrective actions, capping sighs and sealing cracks in the covers of the septic tanks. Other actions were taken for 18 owners in the following days, resulting in 28 successfully directed interventions in the community (Johansen, 2011). No matches can be found for the search term “education” on the proceedings of ICUP at Edinburgh, 1996, for the categories Key Words or Titles. Two presentations therefore are related to *Culex* surveillance and control in urban areas and permit following a discussion on this annoying and vector mosquito. The manuscript “Physical and Chemical Properties of Different Types of Mosquito Aquatic Breeding Places in Kuwait State” by A.M. Salit and co-authors and the poster abstract “An IPM Programme Against *Culex (Culex) pipiens* L., 1758 in Valencia Region (Spain)” by E. Corella and co-authors. In Spain, various control measures were carried out from 1986 to 1995. The authors reported an IPM program directed against immature stages in more than 325 foci detected in the city of Valencia, listing sanitation and the use of chemical and biological insecticides, as well as the use of two cyprinodontidae fishes (*Valencia hispanica* and *Aphanius iberus*). In Kuwait, the team of researchers found *Culex pipiens* in almost all ten types of breeding places, i.e., animal watering basins, seepage of water from agriculture and animal enclosures conditioning, swamps and sewerage water with Gulf water, manure fermentation basins, water irrigation channels, storm drains, sewerage manholes, inspection chambers, artificial lakes with stagnant water and fountains. In both situations, Spain and Kuwait, education or community participation is not enrolled as strategy, but may play a role. Since most of breeding places for *Culex pipiens* complex is manmade, we can find all around the world many good examples of people attitudes helping official control programs, and it must be stimulated.

From 3rd ICUP at Prague, Czech Republic, 1999 to the last one in Budapest, Hungary, 2008 we can identify and summarize two posters and one full paper in 1999, one poster in 2002, four posters in 2005 and two posters and three full papers in 2008 on the ICUP web site search engine, using the term education used for all categories of search.

In 1999, M. Waldvogel and co-authors, published that the ultimate goal of their study was to deliver an education program to production managers to allow them to continue an effective site-based pest management strategy of cockroaches in confined swine production at North Carolina. Dr. Bulent Alten and S. S. Caglar presented integrated control strategies against mosquitoes, house fly and sand flies for the Belek Tourism Center, an area which is surrounded by Mediterranean and called the Turkish Riviera. Accordingly, they outlined education studies as the first step and then, in second place, what they called Integrated Control Studies comprising A. Infrastructure studies and physical arrangements; B. Bio-ecological studies; C. Chemical control studies and D. Biological control studies. Also in 1999, Dr. N. Hill, from the Disease Control and Vector Biology Unit, London School of Hygiene and Tropical Medicine, presented the poster “Why are we failing to control Head Lice with insecticides” enrolling education as a fundamental tool.

The only poster abstract on ICUP 2002 (at Charleston, USA) mentioning education was from B.M. Kard and co-authors. They inform that the need to progressively improve structural and urban pest-management training for state regulatory officials, pest-management professionals, and extension educators has led to the development and implementation of a limited number of university-based training schools in the United States. Then, they presented the goal of an Education Facility for Structural and Urban Pest Control at Oklahoma State University. The objective: “to provide this training relative to subterranean termite management under a variety of standard and unique building materials applications and construction practices found in Oklahoma and contiguous states”, i.e., education for PCOs and technicians and no references to costumers. But in the 2005 ICUP (at Singapore), the poster abstract from A. Morgan seems to have better addressed the role of education for termite control. It was informed that an initiative known as “Operation Fullstop” (from the Louisiana State University Agricultural Center, in cooperation with USDA) began in 1998 and was carried out through a 15-block area in the New Orleans French Quarter. He wrote that the goal of the program, i.e., to reduce densities of the Formosan termite and validate the effectiveness of area-wide management, was achieved, but it became evident, however, that the program

needed to be evaluated from the viewpoint of the participants. He reports then a survey for all the 225 property owners and managers of the original 15-block and concluded that they were knowledgeable about termite biology, identification, prevention, control, and management. Also, the majority of the participants indicated that the program was important, effective, and should be continued and expanded to other areas. For the final lines of his abstract, A. Morgan wrote “Therefore, based on the results of the study, continued research and educational efforts directed towards managing the Formosan subterranean termite would be justified”, and we must congratulate with this approach.

The other three poster abstracts from the ICUP 2005 (at Singapore) mentioning education are from a team of 16 Iranian researchers. Two abstracts were about bed nets and malaria and/or cutaneous leishmaniasis, and the third reports prevalence rates of arthropod borne diseases in children of urban areas of Iran, in order to generate baselines for health education authorities to design a health educational program.

The ICUP at Cambridge and the presentations of those two mentioned (criticized) before researches involving cockroach control, i.e., on the program for a decision aid system involving individual or collective clients’ attitudes and “Cockroach Control in the Netherlands” were in 1993. Fifteen years later, during the IUCP 2008 (in Budapest), one full paper and one poster presentation were on a correlate subject. Respectively, Don Rivard from the Boston University School of Public Health and co-authors presented “Integrated Pest Management Educator Pilot Project” and C. Wang and G.W. Bennett presented “Integrated Pest Management Strategies to Manage Cockroaches and Reduce Cockroach Allergen Levels in Multi-Family Housing”. Both researches are consistently directed to education as a philosophy and as a tool. Don Rivard team proposed a peer educator model (IPM Educator) in public housing as a component of IPM. And they report that, before the product treatment, residents received written notice to prepare their units for the application. And before a second and a third treatment, an IPM Educator instructed residents on cockroach biology and habits, preparation for treatment, and the role of sanitation in pest control. They concluded that the “IPM peer educator is a low-cost model of educating and engaging residents of low- income, multi-family housing. It is also a potential source of professional training and jobs for public housing and other low-income housing residents”. C. Wang and G.W. Bennett reports an IPM program for 400 apartments in Gary, Indiana. The program consisted of demonstration and education of residents, chemical control, and sticky traps. They report that the program was highly effective in maintaining cockroach infestations at very low levels, reducing cockroach allergens, and reducing insecticide use. It seems now that the common setbacks and difficulties related to lack of cooperation from residents have been overcome.

The last report on the IUCP 2008 (at Budapest), to be commented on, is the full paper from Stephen L. Doggett and Richard C. Russell “The Resurgence of Bed Bugs, *Cimex* spp. (Hemiptera: Cimicidae) in Australia”. They are from the Department of Medical Entomology and the University of Sydney. The paper inform that Australia experienced a resurgence of two species of bed bugs resulting in a high economic impact, and a official program was implemented with four points, being the third one the education of stakeholders affected by bed bugs. The government produced, as they cited, “numerous papers (17) for various industries journals, including the following groups; pest managers, hotel/motel management, housekeepers, student accommodation managers, hotel engineers and environmental health officers”. As one of their conclusions, they mentioned that “education and training of pest managers, the accommodation industry and other stakeholders in best practice management is essential in order to ensure proper control is undertaken, which in turn should minimize the spread of the insect”.

Finally, and considering the title of the present panel of discussion (“The Future of the Urban Pest Research”), I am obliged to propose to the next ICIPUE, the panel titled “Researches on Education in Urban Pest Management”.

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