# Agro-shop owners and operators technical knowledge of pesticides and pest management strategies in Trinidad

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**Trinidad is almost self sufficient in the more popular vegetables consumed locally and many studies have pointed to the excessive use of sometimes dangerous pesticides in production. No regulations guide pesticide sale to agriculturists, and agrochemical retailers have been shown to be the main source of technical information for farmers. Seventy five agrochemical retailers in Trinidad were surveyed to determine the most frequently sold pesticides and their knowledge of appropriate and safe crop protection practices for pests, diseases and weeds and knowledge of safety and environmental issues. The results reflected overall fair knowledge in all areas assessed. ANOVA results showed that training prior to employment, training received during employment, perception of present skills and position in the organisation were significantly associated ($p<0.05$ level) with knowledge and skills. The study recommended both the rationalisation of training among the different training agencies and an increased frequency in the immediate future given the potential risks to human health and the environment associated with the communication of incorrect information.**

Keywords: agrochemical retailers, Trinidad, environmental issues, pesticide management

With the ever increasing population in Trinidad and Tobago, there will always be a need for a greater supply of fresh, high quality, safe food to feed its people. Satisfying this demand for food is the very basic goal of regional agricultural production efforts. Crop production is particularly at risk. Losses are more pronounced in the tropics as infestations by insects, fungi, weeds, and other potentially harmful organisms present a major threat to agricultural production and potential losses due to pest infestations vary among crops from less than 50% (e.g. in maize) to more than 80% (e.g. in banana and cowpea) (Brathwaite and Isaac 2012, 167-188). For crop production to meet food security objectives, there must be marked improvement in pests, diseases and weed management. For the multitude of small resource- poor farmers throughout the Caribbean, pesticides, though costly, are the most popular method used to control pests and diseases and weeds. Over time, many of these farmers have developed an unhealthy reliance on pesticides which has become a crucial component towards achieving optimum farm productivity (Damalas et al. 2006, 339-348; Damalas and Eleftherohorinos 2011, 1402-1419).

Adverse side effects of pesticides usually occur from a lack of adequate understanding of their impact. Indeed injudicious pesticide use presents serious threats to the environment and human health, particularly in developing countries (WHO 2008, 20-33). Knowledge about the application of appropriate pest management solutions is, however, lacking in the developing world. This knowledge inadequacy is further compounded by the fact that farmers are at the mercy of preying agro-shop retailers who offer rigorous production and pesticide prescriptions to increase farm productivity. With this in mind, farmers in most developing countries seldom use pesticide products properly, neglect the use of personal and protective equipment (PPE), ignore the ramifications to the environment and usually

ignore legal restrictions. This may often reduce pesticide efficacy, resulting in pest tolerance build-up in the environment as well as exacerbating farmer health related incidence (Damalas and Eleftherohorinos 2011, 1402-1419; Devi 2009, 263-268; Hashemi et al. 2009, 934-939; Polidoro et al. 2008, 98-106; Recena et al. 2006, 230-236; Salameh et al. 2004, 1-6).

Trinidad is almost self-sufficient in the more popular vegetables consumed locally and to cater to the large need for inputs, a plethora of agro-shops have emerged and these are usually located close to the vegetable farming areas. These agro-shops have an important role to play in assisting to improve the production and safety levels of the nation's foods (Badrie et al. 2009, 33-43). Moreover, they play an important role in bringing together the key players in the production process i.e. the input suppliers, field technicians, the public and farmers. Presently, there are about 105 agro-shops in Trinidad and Tobago supplying agriculturists with pesticides, fertilizers, equipment, feeds etc. to improve production levels. One main service provided is education. Agro-shop owners/operators are recognised as the most important source of information to farmers (Pinto et al. 2007, 83-90; Seepersad 2003). Agro-shop personnel assist farmers, students and the general public by providing information on pesticide use, that is, the types of pesticides, pesticide safety, proper pesticide disposal procedures, best pesticide for the pest, when to apply and how much pesticide to apply to the crops or administer to animals. They have in essence assumed the role of the extensionist in transfer of information to the farmer. The situation of education is complicated, however, by the fact that many agro-shops may be operated by persons who have little or no formal training in agriculture. While agro-shop owners may be trained, the shops are usually managed on a daily basis by hired help, often temporary staff who may have little or no formal agriculture training.

Whatever the management system, it is important that the information provided is appropriate, in keeping with best industry practices, and in sync with the national extension education efforts. In such a scenario, it is vital that agro-shop owners and operators be sufficiently knowledgeable in all aspects of crop protection. They can then adequately assist farmers with pest management decisions by providing them with the technical knowledge necessary for the selection of appropriate pest control methods, and their safe and effective use. To plan effective educational programmes for these agro-shop personnel adequate baseline information on their knowledge and skills is needed. Consequently, the major objective of this study was to assess the level of competence on pests and pest management of agro-shop owners and to make recommendations to improve the quality of crop protection information provided by agro-shop personnel to the farming public.

## Materials and methods

The survey was conducted throughout Trinidad, West Indies. Agro-shops located on the main roads in all towns and villages where vegetable production is the dominant farming enterprise were targeted. Some 75 agro-shops operators (71% of population) were surveyed from the 105 shops which are registered with the Pesticide and Toxic Chemical Control Board (PTCCB) of Trinidad. Data were collected between October 2009 and May 2010. A structured questionnaire was administered both by face-to-face interviews with owners/operators at their enterprise, but in most instances questionnaires were left to be completed and followed up with reminders to complete and eventual retrieval. Each survey took approximately fifteen minutes to complete. The aim of the questionnaire was to assess the competence of agro-shop shop owners/operators in pest and pesticide knowledge and management. Competencies were assessed in the areas of pests, weeds and diseases identification and knowledge of effective pesticide recommendations, environmental and safety concerns. Some personal and other data were collected also.

There were five questions which dealt with pest and disease identification and recommendations. They were based on pepper

and cabbage crops as they are the most common vegetable crops prone to pest and diseases attacks. Weed control and recommendations were based on the tomato crop, this being the crop most affected, and again there were five questions. The environmental concerns section comprised seven questions relating to synthetic chemicals harming the environment and actions in the event of spillage of pesticide in the agro-shops. There were thirteen safety practices assessed and these covered areas such as safety equipment required, protective clothing, emergency numbers, pesticide storage and recording the names of persons purchasing Class I and Class II chemicals. Each question was scored as; correct response =1 and incorrect response =0. Score ranges were as follows: 0-5 for pest and diseases identification and recommendations; 0-5 for weed control and recommendation competencies; 0-7 for environmental concerns; and 0-13 for safety practices. Total knowledge score would then range between 0-30. At the end of the questionnaire owners/operators were asked to indicate if they had any training needs and these were noted.

Prior to the administration of the survey, the questionnaire was evaluated for content validity by an entomologist and a pathologist from the University of the West Indies and then pre-tested with a group of students and staff members of the Department of Food Production at the University of the West Indies (n=6) and modified according to comments and suggestions.

Descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics included frequency values (mean and standard deviation) and inferential statistics included means difference (one way ANOVA). All data were analyzed using MINITAB for Windows version 14.0 and Microsoft Excel.

## Results and discussion

Sample description

Table 1 shows the description of respondents. The sample consisted of 75 agro-retailers. The majority of respondents (67%) were males while 33% were females. Some 19% were workers in the organization, 10% held supervisory positions, 25% were managers, and 46% were owners. The majority had secondary level education (68%), and tertiary education (22%) with 10% reporting primary level education. 39% of the respondents were between the ages of 31 to 40, 28% were 41 to 50 years old, 20% were 20 to 30 years, and 13% were more than 50 years old. Some (42%) of respondents reported they worked with the organization for less than 5 years, 24% spent 5 to 10 years, 20% spent more than 15 years; and 14% stated that they spent 10 to 15 years with the organization. A majority of the respondents (53%) had undertaken some agrochemical training while employed with the organization, while 47% did not. A majority of respondents (56%) also believed their knowledge of pests, pesticides and appropriate recommendations to be good, 24% believed theirs were fair and, while 20% perceived it was very good.

**Table 1:** Description of respondents

| | **Personal** | **%** |
|---|---|---|
| *Gender* | | |
| | Male | 67 |
| | Female | 33 |
| *Position in the Organization* | | |
| | *W*orker | 19 |
| | Supervisor | 10 |
| | Manager | 25 |
| | Owner | 46 |
| *Level of Education* | | |
| | Primary | 10 |
| | Secondary | 68 |
| | Tertiary | 22 |
| *Age* | | |
| | 20-30 | 20 |
| | 31-40 | 39 |
| | 41-50 | 28 |
| | >50 | 13 |
| *Length of time in the organization:* | | |
| | <5 years | 42 |
| | 6-10 years | 24 |
| | 11-15 years | 14 |
| | >15 years | 20 |
| *Training in agro chemicals* | | |
| | Yes | 47 |
| | No | 53 |
| *Perception of skills* | | |
| | Fair | 24 |
| | Good | 56 |
| | Very Good | 20 |

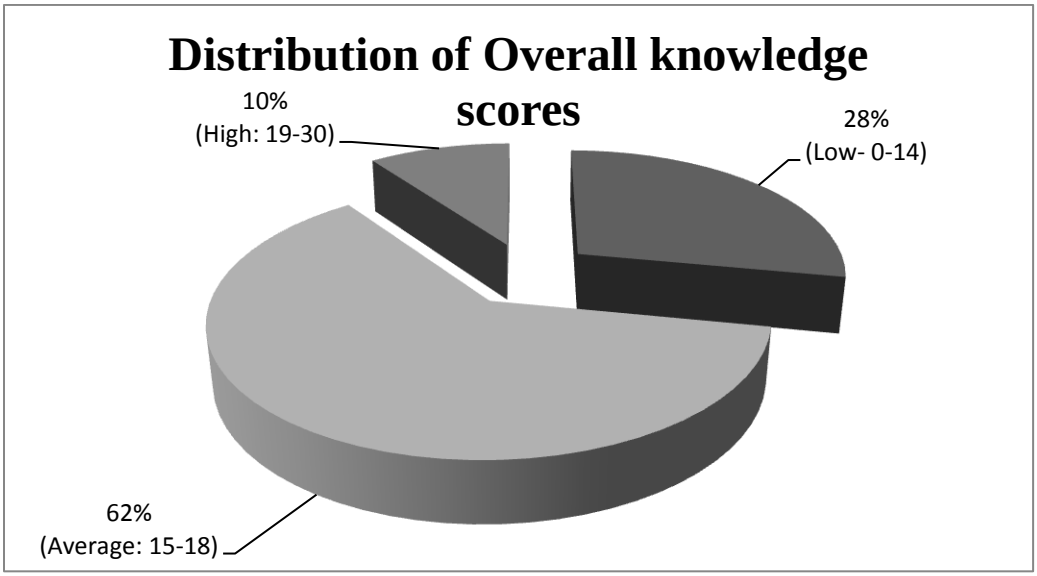


**Figure 1:** Percent distribution of scores for knowledge of pests, diseases, weeds, weed management, environment issues and safety precautions.

**Table 2:** One way ANOVA of personal variables on overall knowledge score and knowledge scores for pests and diseases, and weeds

| Variables | | N** | Mean (SD) | F (P) |
|---|---|---|---|---|
| **Overall Knowledge (0-30)** | | | | |
| *Training during employment* | Yes | 52 | 16 (0.41) | 5.55* |
| | No | 22 | 14.2 (0.6) | (0.02) |
| *Perception of skills possessed* | Fair | 18 | 13.7 (0.67) | 5.06* |
| | Good | 42 | 15.7 (0.44) | (0.01) |
| | Very Good | 15 | 16.7 (0.74) | |
| **Knowledge of pests and diseases and their management (0-5)** | | | | |
| *Position in organization* | Worker | 13 | 2.4 (0.28) | 3.39* |
| | Supervisor | 7 | 3.0 (0.38) | (0.02) |
| | Manager | 19 | 3.4 (0.23) | |
| | Owner | 34 | 3.3 (0.17 | |
| *Prior training in pesticides* | Yes | 35 | 3.4 (0.17) | 6.23* |
| | No | 39 | 2.8 (0.16) | (0.01) |
| **Knowledge of weeds and weed management (0-5)** | | | | |
| *Training during employment* | Yes | 50 | 2.3 (0.09) | 6.59* |
| | No | 18 | 1.8 (0.14) | (0.03) |

**Significant at 5%* ***Differences in N due to non-response*

Knowledge of crop protection practices

Figure 1 shows the percent distribution of scores for knowledge of pests, diseases, weeds, weed management, environment issues and safety precautions

The overall knowledge scores ranged from 0-30, with the sample mean being 15.5

(SD= 3.0). The mean pesticide knowledge score (range 0-5) for sample was 3.2 (SD= 1.0). Similarly, knowledge of weed mean score (range 0-5) was 2.1 (SD= 0.63), mean knowledge score of the environment concerns (range 0-7) was 3.5 (SD= 1.3) and mean safety score (range 0-13) was 7.5 (SD= 0.8).

ANOVA findings

Table 2 shows the one way ANOVA of personal variables on overall knowledge score and knowledge scores for pests and diseases, and weeds. Overall knowledge was significantly different based on "Training during employment" (F= 5.55, df= 1) and explained 10% of the variance in overall knowledge ($\eta^2$ =0.10). Overall, persons who received training during employment were more knowledgeable (M= 16, SD= 0.14) than those who had no on the job training (M= 14.2, SD= 0.6).

There was also significant difference on overall knowledge based on "Perception of skills possessed" (F= 5.06, df= 2). Tukey's b post hoc analysis showed a significant difference ($p < .05$) between persons who perceived they skill levels as fair (M= 13.7, SD= 0.67), and those who felt they had good set of skills (M= 15.7, SD= 0.44), and very good skills (M= 16.7, SD= 0.74) on agropests and diseases, their management and environmental and safety issues. Those who perceived that they possessed good and very good skills were more knowledgeable than those reporting fair skills levels.

There were also some significant differences between the personal variables and knowledge of the individual areas assessed. The pesticide knowledge of persons was significantly different based on the "position held within the organization" (F: 3.39, df= 3). The effect size was small ($\eta^2$ = 0.13) and Tukey's b post hoc comparison test revealed a significant difference between persons employed as "workers" and "managers". Respondents who were managers (M= 3.4, SD=0.28) were more knowledgeable on pest identification and management than workers (M= 2.3, SD= 0.23). There was also a significant difference on "Prior training in pesticides use" on the pesticide knowledge score (F: 6.23, df=1). The effect size was small ($\eta^2$ = 0.10). Respondents who had prior training in pesticide use (M=3.4, SD= 0.17) were more knowledgeable on pesticide identification and management than those who had no prior training (M= 2.8, SD= 0.16).

On the "weeds and weed management" knowledge score, there was a significant difference with "Training during employment" (F: 6.59, df = 1). Respondents who undertook training during employment were more knowledgeable (M= 2.3, SD= 0.09) on weed control than persons who had no training during employment (M=1.8, SD=0.14).

Based on the overall knowledge scores, the results showed that agro-input workers, regardless of their position in the organization, had fair overall competencies in the identification of pests, diseases and weeds, their management strategies and about environmental and safety concerns. Moreover, the results showed that in the four individual areas assessed, the mean scores reflected moderate knowledge, implying that all areas of crop protection need to be improved equally. Since agro-shops have been reported as the most important source of farmer's information in Trinidad, this level of competency needs to be improved significantly and urgently. Agro-shop personnel must be empowered to convey accurate information at all times to purchasers. If this is not done, then food producers, consumers and the environment are at risk.

The ANOVA results highlighted the importance of on- the- job training on overall knowledge. Those who received training during employment were more knowledgeable than those who did not. Moreover, those who received training are more likely to perceive their skills set as better than those who do not receive training. Mean scores showed that they were more knowledgeable on the job. Training on the job is offered by both the public and private extension services. Such training is voluntary and is focused on the identification of pests, diseases and weeds, and their management strategies. Training is also offered by the Pesticide Toxic Chemical

Control Board (PTCCB) of Trinidad and Tobago and is focused on safety and environmental issues. This training is mandatory for owners of agro-shops as part of their certification and licensing agreement. Because of the importance of continuous training on the job, as evidenced from this study, both training experiences need to be rationalized. All training experiences should incorporate all areas of crop protection as well as safety and environmental issues and should be mandatory because of the potentially huge negative impacts. Two issues are important. Firstly, Trinidad imports over $US 36 million annually in pesticide products, which is quite a lot for a farming population of approximately 20,000 persons and secondly, Trinidadians eat a lot of vegetables, either raw or partially cooked (Badrie et al. 2009, 33-43). If pesticides are used injudiciously the consequences will be serious because of the potential negative impact both on the consuming public and on the fragile ecosystems and the environment.

## Conclusions and recommendations

There is need to improve the competencies of agro-shop personnel, at all levels and in all areas of crop protection, safety on the job and environmental issues. The misuse or misguided pest management information provided by many agro-shop personnel indicate that there is a lack of education in many of these suppliers. This may be due to (1) the level of formal education to which the owner or operator has been exposed; (2) the lack of knowledge and understanding of pests and diseases; (3) the lack of knowledge of the mode of action of many pesticides. Training on the job has been shown to be a determining factor in improving knowledge levels and should be rationalized and mandatory, given the potential risks of inadequate knowledge. Training opportunities should be increased in the short term to close the present, identified gaps in technical knowledge. Agro-shop owners/operators should also be involved and trained to appreciate the concept of integrated pest management. The Farmer Field Schools approach has been successfully used in the region and may be appropriate in this instance. This can help reduce this unnatural and heavy dependence on pesticides and at the same time increase farmers' understanding of how to manage their agro-ecosystems with minimum pesticide use. It is important that regulatory authorities take factors such as culture, the level of education and awareness and "willingness to change" into consideration when developing systems of monitoring and control.

Trinidad is the most vibrant economy in the English-speaking Caribbean and is the major distributor of pesticides to the smaller Caribbean countries. The large suppliers and owners of agro-shops are involved in this trade. Information on use is often provided freely with the products sold to these overseas customers and to the extent that knowledge is inadequate among the sources of information, then the information provided will not be in keeping with best industry practice. The risk that the farmers and consumers in Trinidad face will be replicated around the region. This has huge consequences for regional health and the environment.

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